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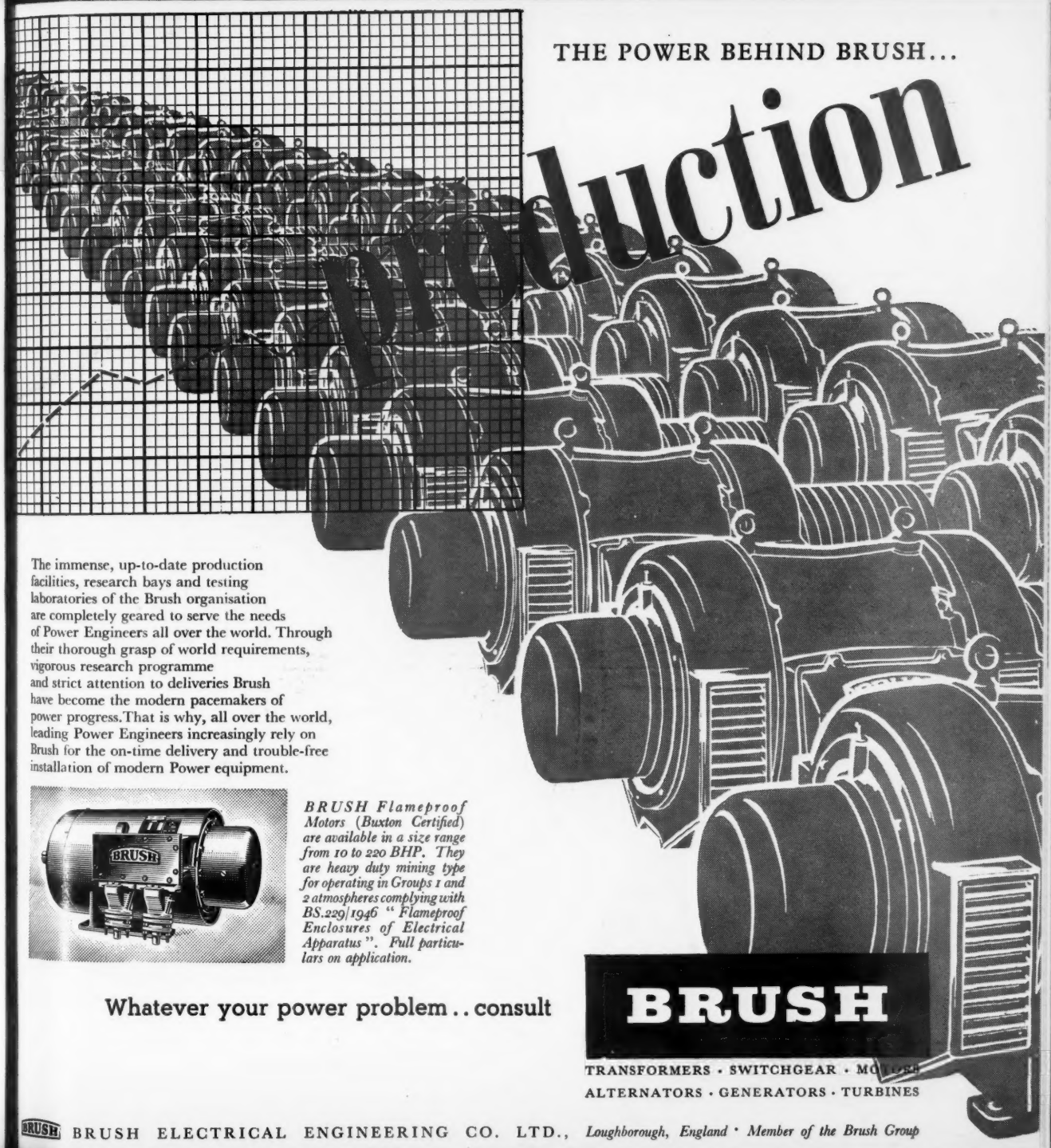

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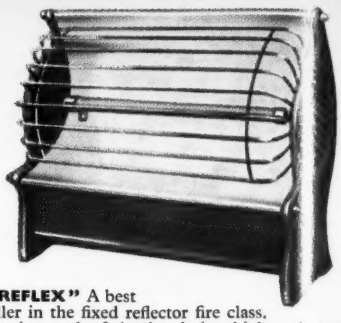

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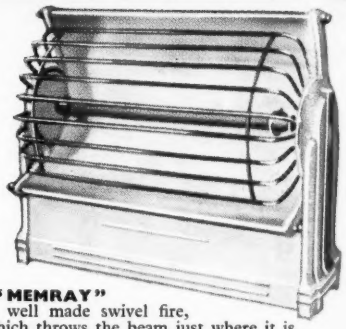

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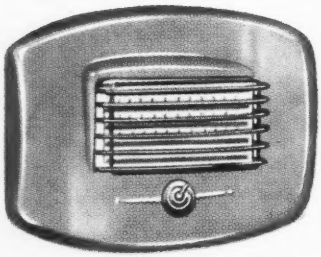

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Managing Editor: HUGH S. POCOCK, M.I.E.E.
General Editor: J. H. COSENS
Technical Editor: P. W. TUCKER, M.I.E.E.

15 JULY 1955

In This Issue

99 EFFECTS OF AUTOMATION
101 CURRENT TRANSFORMERS
105 E.I.B.A. ANNUAL MEETING
106 C.E.A. LABORATORIES
109 WORLD ELECTRICAL MARKETS—SOUTH AFRICA
111 INTERNATIONAL ELECTROTECHNICAL COMMISSION
112 PARLIAMENTARY REPORT
114 PERSONAL AND SOCIAL
119 VIEWS ON THE NEWS
121 PRINTING EXHIBITION
122 WORLD POWER CONFERENCE
123 CHADDERTON "B" POWER STATION
129 THE ROYAL SHOW
132 GENERATION AND DEVELOPMENT
133 INDUSTRIAL NEWS
137 NEW ELECTRICAL EQUIPMENT
138 TASMANIAN POWER SCHEME
140 FINANCIAL SECTION
145 CONTRACT INFORMATION
146 NEW PATENTS

117 REGIONAL GUIDE TO ELECTRICAL CONTRACTORS
121 CLASSIFIED ADVERTISEMENTS
134 INDEX TO ADVERTISERS

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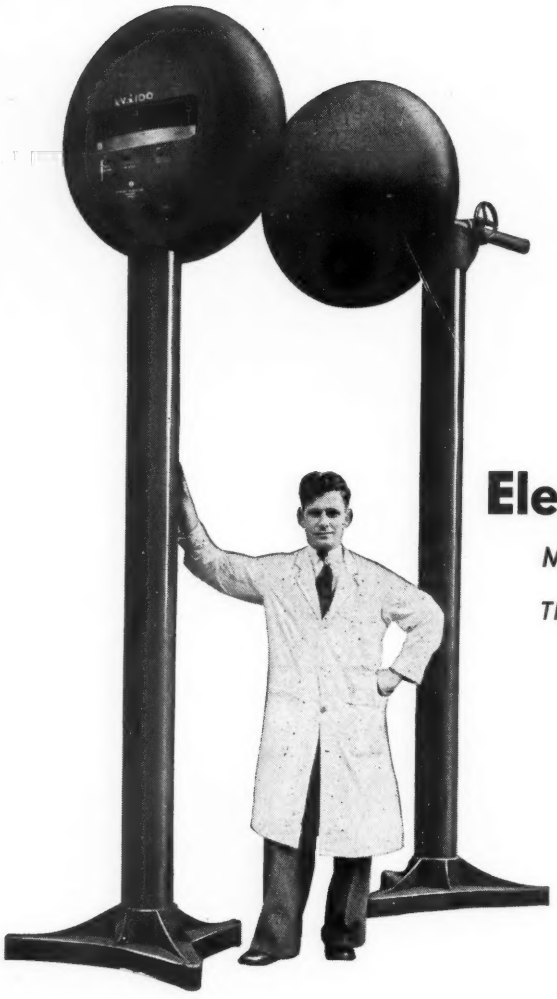

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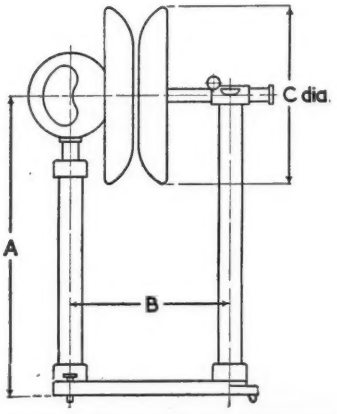

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All have several ranges and may be dismantled for transport. Special carrying cases can be supplied.

Other types are available for switchboard or portable use for voltages down to 750V.

MODEL	A		B		C	
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ELECTRICAL REVIEW

15 July 1955 Vol. 157 No. 3 Established 1872

Effects of Automation

As the primary instrument of " automation " the electrical industry is deeply concerned with its effects both industrial and social. The subject is very much under discussion at the moment and will become increasingly urgent. One of the latest studies of the subject was that of P.E.P. (Political and Economic Planning) reviewed in our last issue, and various aspects of the subject were considered at the recent Margate conference of the Institution of Production Engineers (*Electrical Review*, 24th June).

Automation is not new; for very many years individual machines have been designed to carry out operations " by themselves " and automatic control of processes is common practice. The novelty resides in the rapid advances in the art made possible by " electronic " methods, particularly in the application of computer control in a number of directions. The electrical industry will be the principal provider of the equipment which automation requires and there will be an enormous call, additional to the present heavy demand, for electrically (not just electronically) trained men of high quality. In fact progress depends upon the rate of supply of such men.

Given that supply, automation may bring about an industrial revolution reaching farther than that of last century. Already fears have been expressed by some trade unionists that the result of speeding up production and at the same time drastically reducing the labour required will lead to extensive unemployment. This is the argument which was used by the Luddites and proved false in the event: it is not shared by responsible union leaders. At the same time if automation is proceeded with rapidly there must be rapid adjustment to it to avoid harmful effects. There is obviously going to be a disturbance of labour which will have to be absorbed either by extended shift work or transferred to other fields of activity.

It is believed that the improvement and increase in production will bring about a revolution in living standards. This must be the case unless automation is to result in spasms of activity followed by long idle periods to allow consumption to catch up with over-production. This pre-supposes lower prices or higher wages in order that there shall be a market for the greater output. Reduced hours of labour and increased leisure are also visualized. Part of that " leisure " will be employed by the more intelligent members of the labour force in equipping themselves for the greater need of industry for technicians; many others will have more time for cultural or athletic activities. How the spare time of the rest will be occupied may prove a difficult social problem.

OPERATIONAL RESEARCH

At first sight it might appear that the research laboratories of the Central Electricity Authority at Leatherhead merely duplicate the work of other research organizations—direct or otherwise. This is far from being the case. These laboratories, which have recently been extended and are described in this issue, are primarily intended to assist in the solution of problems which arise in the operation of the nation's generation, transmission and distribution system. Breakdowns and operational difficulties are the special concern of the laboratories, which are equipped and ready to find a cure for whatever trouble may arise in the minimum of time. This does not mean, however, that long-term research is not undertaken. Investigation into breakdowns often provides the "raw material" for more fundamental work, the results of which may ultimately be used in practice. One interesting problem at present being investigated is connected with the cross-Channel cable and an electronic computer is under development to hold automatically the system frequency to 50 c/s by continuously adjusting generating plant all over the country to meet random load fluctuations.

FUEL COSTS

Though some increase in the price of coal had been expected, the 18 per cent rise announced last week—the largest of the series in recent years—came as a shock to industrial and domestic consumers alike. As far as the electricity supply industry is concerned the extra cost is expected to be in the region of £20 million a year, part of which will be automatically recovered from industrial consumers under the tariff coal clause adjustments. The most serious aspect of this increase, as the National Union of Manufacturers points out, is that it must inevitably "force up prices to the detriment of our competitive power abroad and at the risk of a further round of wage increases at home." This, together with the growing prospect of a coal shortage ahead, re-emphasizes the urgent need for developing alternative power sources wherever possible—nuclear, hydro-electric (including the North Wales schemes the Bill to authorize which received its second reading in the House of Commons last week) and oil.

MATERIALS HANDLING PROBLEM

In his paper in the symposium "Electricity and the Industrial Future" presented at the British Electrical Power Convention, Mr. B. L. Metcalf referred to "waste stowing" in the mines as an operation which called for specialist help from outside the industry. At the moment, he said, the only satisfactory way of doing this was by means of compressed air, but this was uneconomical and some means of mechanical stowing was badly needed. This, we are quite certain, is a problem the solution of which is by no means beyond the capabilities of the modern individual electric drive, with its inimitable precision electric control, and the modern materials handling machine. Of course, materials handling methods of to-day were not even thought of when mechanical handling had already made great progress in coal mines twenty or more years ago. But the older and more restricted development in the mine and the newer more freely developed section in, say, light industry, have both attained outstanding success largely through the contributions of the electric drive and control. There is no reason why co-operative effort should not find an answer to the new mine materials handling problem of "waste stowage."

CONTINUITY OF SUPPLY

This is a perennial subject for electrical controversy, and one referred to by the authors of two of the important papers in the symposium "Electricity and the Industrial Future"—Mr. W. F. Cartwright, in connection with the steel industry, and Mr. B. L. Metcalf, representing the coal industry. Although both authors dealt with the subject as one of outstanding importance to their respective industries, neither of them advocated the use of private generation on the score of unreliability of public supply but thought it desirable for other reasons. Twenty, or even only ten, years ago, in both of these great industries, one heard quite frequently of new enterprises starting off with private generation purely because of the uncertainty of public supply. But now industry generally sees in public supplies economic advantages which can be gained at a very small risk of failure. Sometimes, too, even the advantages of private generation in connection with process heating give way before the new outlook.

PATENTS POSITION

In common with most branches of science and engineering the Patent Office is suffering from a shortage of qualified men. As a result the arrears of unexamined specifications rose last year to nearly 26,000. There was a small net decrease in the staff but a substantial rise in the total of complete specifications filed which does not indicate any alleviation of the situation. Expenditure exceeded the receipts and although increased fees have been sanctioned a further rise seems to be unavoidable if the Office's budget is to be balanced. Electrical inventions naturally continued to form a substantial part of the whole. Devices and improvements in the old-established lines were numerous and there was a greater upward trend in the number of inventions in the newer techniques, e.g., electronic computers, transducers, transistors and spark erosion. A summary of the report of the Comptroller-General appeared in our last issue.

HAIR DRYERS

In our series of illustrated surveys of domestic electrical appliances we shall be dealing next week (22nd July) with hair dryers. Particulars to be given in tabular form will include details of weight, loading, special features, finish and price. In view of the continued demand for these surveys for reference purposes, orders for additional copies of the *Electrical Review* should be placed without delay

Current Transformers

Their Behaviour in Balanced Circuits

By J. H. TOULE, B.Sc., A.M.I.E.E.*

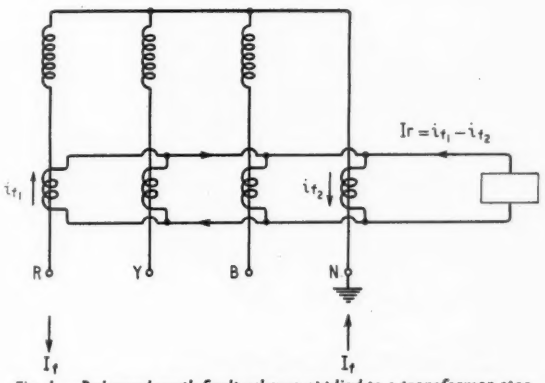


Fig. 1.—Balanced earth fault scheme applied to a transformer star winding

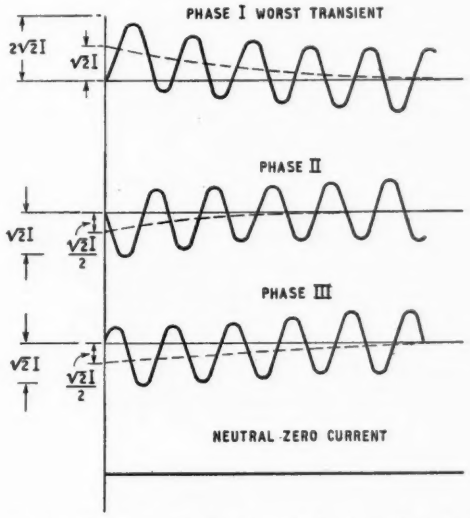


Fig. 2.—Illustrating transients in c.t.'s for three-phase fault

A GOOD deal has been written about the various aspects of the behaviour of current transformers in balanced circuits, but it is invariably cloaked with an air of mystery, with vague references to saturating c.t.'s, and transient instability. This article attempts to present enough information to the engineer, faced with commissioning a balanced protection scheme, to enable him to predict its behaviour and to understand the principles involved. This is particularly desirable in temporary protection where it may be necessary to use an existing set of c.t.'s, which have not been specially matched for the purpose during manufacture.

Relay Stability

Fig. 1 shows a typical circuit for balanced earth fault protection applied to a transformer. The same principles still apply to a Merz-Price system of overall protection, or to busbar protection with many sets of c.t.'s paralleled on to a common relay. The first consideration is the stability or non-operation of the relay on external faults. Taking first a fault current I_f which represents an earth fault outside the protected zone, if the c.t.'s on the R phase and neutral phase are of the same ratio and give the same output, then it is clear that the relay current must be zero. This, unfortunately only holds good if the c.t.'s reproduce the primary current faithfully, the interconnecting leads are of negligible resistance, and the relay circuit presents a high burden.

The principal cause of c.t.'s failing to balance or maintain their ratio is the handling of unequal transients in the primary circuit by the c.t.'s contributing to the circulating current i_f. Fig. 2 illustrates the worst transient obtained from a three-phase fault; this gives rise to a maximum transient value of $2\sqrt{2}i$ on one phase, and of $\sqrt{2}i$ on the remaining two phases. Fig. 3 shows the distribution of fault currents on a multi-earthed system with an earth fault on one line. For the worst case where all the fault current passes through the one neutral associated with the balance circuit, as in Figs. 3 and 4, the worst transient seen by the neutral c.t. will have a maximum value of $2\sqrt{2}i$ whilst each of the line c.t.'s will have a maximum value of $\frac{2\sqrt{2}i}{3}$. Thus it can be seen that with certain types of external faults which are quite common, one c.t. may have up to three times the duty of the remaining c.t.'s contributing to the balance current.

It is often stated that the effect of a transient is to cause saturation of a c.t. It can be shown that the maximum

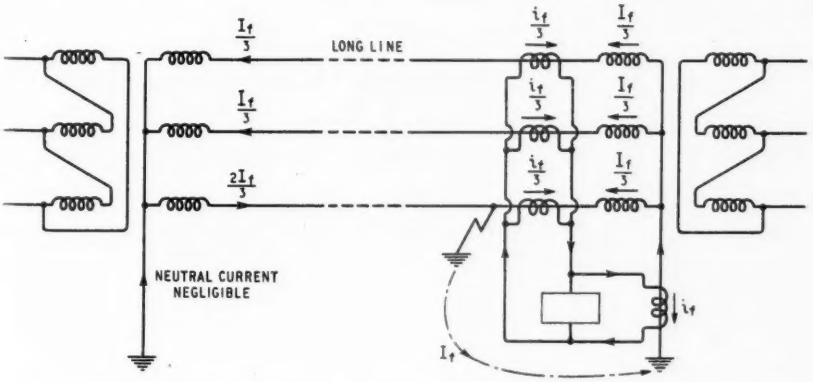


Fig. 3.—Distribution of fault currents in extreme case with earth fault just outside transformer

* South Western Division, Central Electricity Authority.

flux which can be produced under the worst transient is $= \phi \left(\frac{X}{R} + 1\right)$ where ϕ is the maximum flux in a c.t. core under steady state maximum through fault conditions, X the system reactance up to point of fault, and R the system resistance up to point of fault. The $\frac{X}{R}$ ratio may vary from 5 in distribution systems to 20 or more on large generators. So, it can be seen that the flux in the core of the c.t. carrying the worst transient may be up to twenty times as great as for the steady state under bad transient conditions. If the remaining c.t.'s are only carrying one third of the transient as in the earth fault case of Figs. 3 and 4 the maximum flux may only be up to seven times normal and so it is likely that these c.t.'s will reproduce the transients faithfully and try to balance against the badly saturated c.t. above, resulting in a considerable transient out of balance current through the relay.

In this event, it may be necessary to use a definite minimum time induction relay with a minimum operating time in excess of the transient die away time so that it will be responding only to steady state out of balance. With a severe transient, this may be in the order of 0·25 sec. An alternative is to use a form of magnetic balance relay as in Fig. 5. This employs distinct operating and restraint bias functions and has the advantage that so long as the c.t.'s can produce sufficient voltage to overcome the relay burden, they may have quite different characteristics. A through fault will cause current to flow through the restraint winding ensuring that the relay will remain stable in spite of any out of balance current flowing in the operating coil. There are many relay systems employing this principle including " Duo Bias " and the older balanced beam relays.

By making the relay circuit of high impedance, it may still be possible to retain the balance current circuit. Normally this is done by inserting a stabilizing resistance Rv in series with the relay. The value of this resistance is critical in determining the stability of the relay on through faults. Fig. 6 shows the distribution of voltage in a balanced high impedance relay circuit and the circuit constants are given below.

V_1 = Voltage of best c.t. for magnetizing current Im past the knee point on mag. curve of Fig. 7.
V_2 = Voltage of c.t. with lowest voltage for magnetizing current Im (Fig. 7).
R_1 = Loop resistance of c.t. 1 circuit, from relay tee-off point a through c.t. and back to b.
R_2 = Loop resistance of c.t. 2 circuits (the greater).
n = C.t. ratio.
I_f = Primary fault current.
i_f = Max steady state through fault current in c.t. secondary.
$= \frac{\text{primary fault current}}{n}$.
Vkp = C.t. voltage at knee point from magnetizing curve of Fig. 7.
Rv = Resistance of stabilizer.
Vr = Voltage across relay circuit.
Ir = minimum operating current of relay.

It can be shown that the voltage across the relay circuit under through fault conditions is $i_f \frac{(V_1 R_2 - V_2 R_1)}{V_1 + V_2}$.

If the values of R_1 and R_2 were chosen in relation to the c.t. magnetization voltage V_1 and V_2 so that $V_1 R_2 = V_2 R_1$ then the voltage across the relay would be zero and complete stability achieved. This would correspond to the relay being connected at point Y in Fig. 6. This is a relatively simple matter if steady state conditions only are considered, the average voltage V being determined as in Fig. 8. Under a bad transient, however, at least one c.t. will experience the equivalent of a voltage $\left(\frac{X}{R} + 1\right) V_1$ which

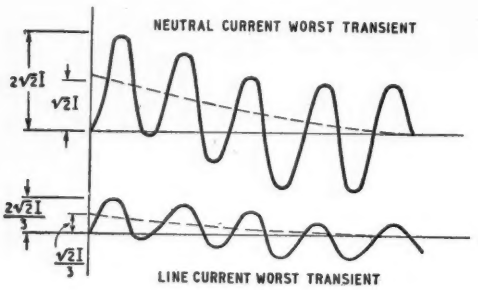


Fig. 4.—Illustrating transients in c.t.'s for earth fault

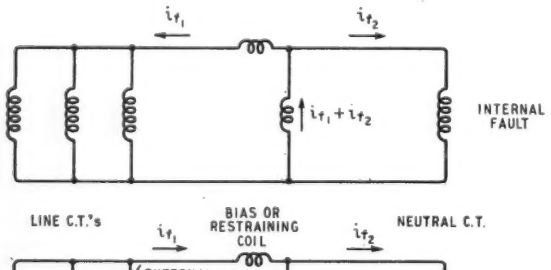


Fig. 5.—Biased relay system for use with badly matched c.t.'s

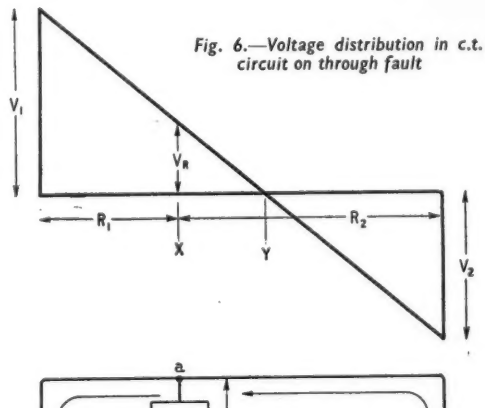


Fig. 6.—Voltage distribution in c.t. circuit on through fault

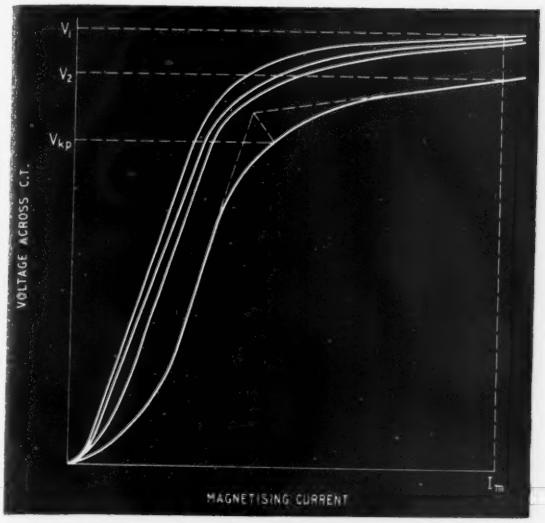


Fig. 7.—Saturating voltages developed by c.t.'s

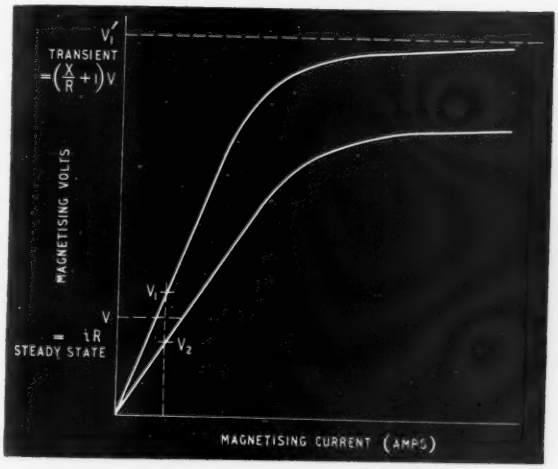


Fig. 8.—Voltages produced by c.t.'s

may be in excess of the maximum saturation voltage Vkp of the c.t. For practical purposes therefore, it is assumed that one c.t. saturates completely and therefore $V_2 = 0$

$$\text{then} \quad Vr = i_f (R_2)$$

$$\text{now} \quad Ir = \frac{Vr}{Rv}$$

$$\therefore \quad Rv = \frac{Vr}{Ir} = \frac{i_f R_2}{Ir}$$

To cater completely for the effect of transients, if the relay is capable of operating within one half cycle the peak value of i_f must be taken $= \sqrt{2} i_f$ and multiplied by 2 to give the effect of the transient, see Fig. 2.

$$\text{then} \quad Vr = 2\sqrt{2} i_f R_2$$

$$\text{and} \quad Rv = \frac{2\sqrt{2} i_f R_2}{Ir}$$

If, however, Ir represents the r.m.s. operating current of the relay, then the factor $\sqrt{2}$ may be eliminated. It must now be ascertained that c.t.'s can produce sufficient voltage to operate the relay through Rv under internal fault conditions. Usually a factor of safety of 2 is taken so that Vkp must be greater than 2Vr. If Vkp is less than 2Vr it will be necessary to use either a biased form of protection as in Fig. 5 or an induction type relay.

The stability ratio or factor of safety on stability is given by

$$S = \frac{Vkp}{i_f R_2}$$

for the transient condition this becomes $\frac{Vkp}{i_f R_2} \frac{R}{(X + R)}$ and if this equals or exceeds unity then the c.t.'s will never saturate and a stabilizing resistance should not be necessary.

For biased relays, it can be shown that the stability ratio

$$\frac{\text{Op. coil current for operation at given through amps}}{\text{Actual op. coil current at given through amps}} = \frac{(Ir + Bi_f)\, Zo}{i_f R_2}$$

where B = Bias ratio

$$= \frac{\text{Op. coil amps}}{\text{Restraint coil amps}}$$

for relay to just operate.

Zo = Impedance of operating coil.

The setting of a biased relay in terms of line current is given approximately by the expression

$$i_1 = \frac{Io - i_2}{1 - B}$$

where i_1 = Line c.t. output, i_2 = Neutral c.t. output, and Io = Min. operating current for relay with no bias. If B is greater than unity this relay cannot operate at all unless the neutral current i_2 is greater than Io and at marginal values the line current required for operation will be excessive. This means that a fault on a transformer drawing nearly all the fault current from the line c.t.'s with very little from the neutral may not clear correctly. This condition can arise on a small capacity transformer run in parallel with several large transformers which will supply most of the neutral fault current.

In order to illustrate the calculations for unbiased relays a typical problem is given below. It is required to commission a system of balanced earth fault protection comprising three line c.t.'s, one neutral c.t., and an instantaneous type attracted armature relay.

The details are:

C.t. ratio n; 250/0·5 = 500.

Relay rated current = 1 amp.

Relay setting 20% — 100% in 10% steps.

Take 20% then $Ir = 1 \times \frac{20}{100} = 0{\cdot}2$ amp.

Greatest loop resistance R2 = 1·5 ohms. (See Fig. 9.)

Through fault current; 5,000 amps.

System $\frac{X}{R}$ ratio = 15.

In the absence of c.t. magnetization curves from the manufacturers, the c.t. characteristics may be determined by test as follows. Each c.t. is disconnected from its external secondary circuit and a voltage applied across its secondary winding from a variable voltage transformer. The voltage is brought up from zero and values of the magnetizing current for a range of voltages tabulated up to the point at which the current increases with little or no increase in voltage. A good rule is to continue up to the rated current of the c.t.

A true magnetization curve will only be obtained if a

true current sine wave is obtained from the test set. As there are practical difficulties in obtaining this, it is usual to accept the curves obtained from a voltage sine wave as standard.

From these tests, a family of curves as in Fig 10 can be produced. Multi-range meters are usually regarded as being sufficiently accurate for measuring voltage and current, although it must be realized that considerable waveform errors will be introduced by rectifier instruments due to saturation effects in the c.t. core at high magnetization currents.

Vkp of worst c.t. from curve (Fig. 10) = 200 V.

$$\text{C.t. sec current} = \frac{5{,}000}{500} = 10 \text{ A.}$$

Stabilizing resistance required

$$Rv = \frac{2\sqrt{2} \times 10 \times 1{\cdot}5}{0{\cdot}2}$$

$$= 212 \text{ ohms.}$$

$$\text{So} \quad Vr = 212 \times 0{\cdot}2$$

$$= 42{\cdot}4 \text{ V}$$

$$\text{and} \quad 2Vr = 84{\cdot}8 \text{ V}$$

which is less than Vkp = 200 V. Therefore the operating margin is satisfactory.

$$\text{Stability ratio} = \frac{200}{10 \times 1{\cdot}5} \times \left(\frac{1}{15+1}\right)$$

$$= 0{\cdot}835$$

So that one c.t. will always saturate under most conditions. Even if calculation shows that a stabilizing resistance is not necessary it can do nothing but good provided that the voltage Vkp from the worst c.t. exceeds twice that required to force the minimum operating current through the stabilizing resistance.

When employing stabilizing resistances of comparatively high values and particularly when the c.t.'s draw high magnetizing currents at the operating voltage Rv, it will be necessary to check the sensitivity of the relay to internal faults. The secondary component of the primary current I_f is given by $\frac{I_f}{n}$. This has also to supply the magnetizing current of itself and all the idle c.t.'s.

So, for a 3 phase and neutral c.t. combination, the relay current will be $= \frac{I_f}{n} - 4Im$ where Im = magnetizing current at operating voltage Vr.

$\therefore$ I_f (for minimum operation) $= (Ir + 4Im)\, n$.

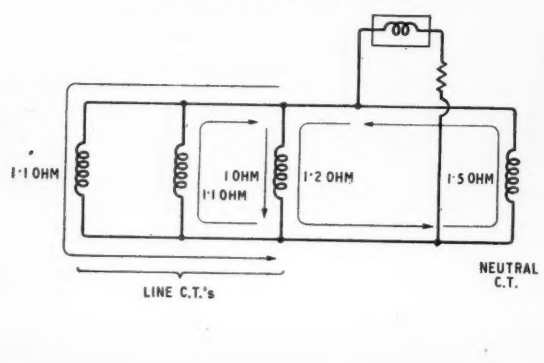
In the example given, the total magnetizing current at the relay operating voltage 42·4 can be read from the curve (Fig. 10) and is (0·05 + 0·04 + 0·08 + 0·06) = 0·23 A.

The relay minimum operating current for 20% setting is 0·2 A.

$$\therefore \quad I_f = (0{\cdot}2 + 0{\cdot}23)\, 500$$

$$= 215 \text{ A.}$$

Fig. 9.—C.t. loop resistances in example



This calculation may be repeated for the remaining relay settings, e.g. for 30% setting.

$$\text{Vr will be } 42{\cdot}4 \times \frac{30}{20} = 63{\cdot}6$$

the total magnetizing current at this voltage is (0·1 + 0·08 + 0·05 + 0·04) = 0·27 A and I_f = (0·3 + 0·27) 500 = 285 A.

This somewhat laborious calculation may be avoided by carrying out a sensitivity test on the relay circuit. Usually the simplest method is to inject current from a secondary injection test set across the relay and stabilizing resistance with no wiring disturbed. The current required to operate the relay on each plug setting is measured. These values multiplied by the c.t. turns ratio will give the equivalent primary current and the curve as in Fig. 11 can be produced.

It is essential that the test set is capable of producing a voltage sufficient to operate the relay at the highest settings. For instance, in the example taken, the maximum setting of the relay is 1 A and the stabilizing resistance is to be 212 ohms. Therefore, the voltage required to inject 1 A through the relay will be:—

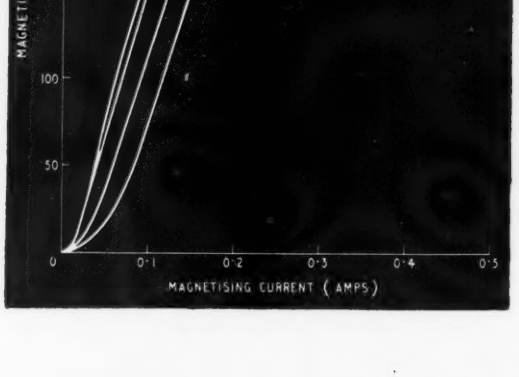
$$1 \times 212 = 212 \text{ V}$$

which must be available from the test set output.

It is also important that the current output of the test set should be sinusoidal, otherwise waveform effects will be present which do not comply with actual fault conditions. This implies that enough resistance should be put in series with the test transformer to constitute the majority of the burden. In this way the initial test transformer voltage would need to be several times greater than the 212 V required for the test load. As this is not often possible, the ensuing errors must be accepted. The alternative is to carry out the same test by direct injection on one of the c.t. primaries if a suitable controlled heavy current test supply is available.

Fig. 11 illustrates the primary currents for operation at the various relay settings calculated on this basis. It is evident from this curve that for a given stabilizing resistance, there can be a maximum relay setting above which there will be insufficient voltage available from the c.t. to give

Fig. 10.—Magnetization curves of c.t.'s used in example



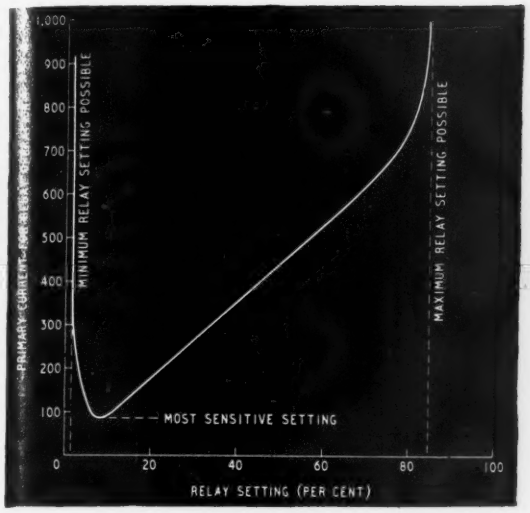


Fig. 11.—Typical sensitivity curve

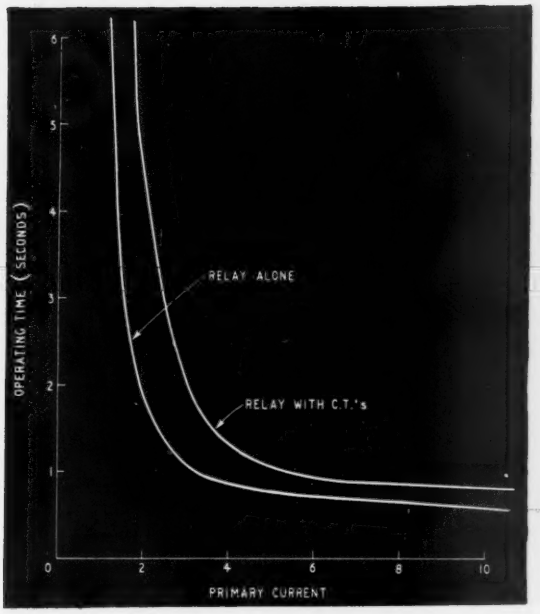


Fig. 12.—Time/current curve of induction relay with c.t.'s connected

operation on an internal fault. Also with a high burden relay, the burden at the minimum setting could exceed that of the stabilizing resistance and cause the rising characteristic at the start of the curve in Fig. 11.

It is equally necessary to carry out a similar test when using induction relays of high burden. In this case, it is not only the minimum operating current which is important, but the whole range up to the saturation current of the relay which will be in the region of 10 times the minimum. Fig. 12 shows a timing test curve carried out on a relay together with a similar test with the c.t.'s in parallel.

E.I.B.A. Annual Meeting

SIR JOHN DALTON, the retiring president of the Electrical Industries Benevolent Association, said at the annual general meeting on 5th July that the continued expansion of the Association's work was perhaps the most marked feature of 1954. To meet the mounting claims on its resources imposed on all in the Association the task of enlarging rapidly the band of workers and subscribers, so that as the number of people to be helped grew beyond the present total of nearly 2,000, their call could be answered.

Mr. H. A. Deacon, chairman of the Court, said that there had been a continued and gratifying increase in the number of people who realized that, although their problems were not financial, they could bring them to the Association for solution. There had been many benefactions during the year and he thanked all subscribers and particularly branch officers, committee members, collectors, organizers and others for seeking out and helping those needing assistance; for collecting subscriptions; and for organizing dances, golf tournaments, and other money-raising events.

Sir John Dalton, in proposing the appointment of Mr. Harold Bishop as the new president, expressed the Association's pleasure at the knighthood conferred upon him by the Association's Patron, Her Majesty the Queen. The motion was seconded by Sir Noel Ashbridge.

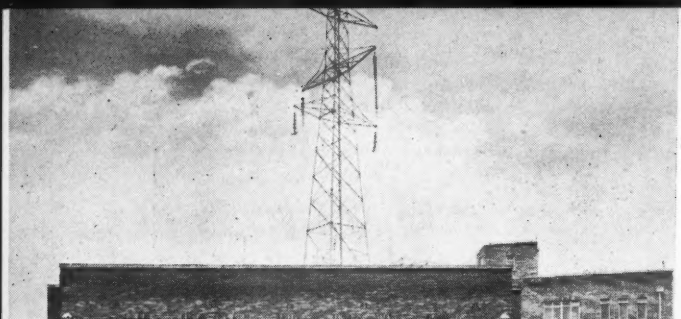
Mr. A. E. Page, chairman of the Finance Committee, said that the E.I.B.A. derived its vigour from the devotion of its branch officers and the hundreds of others to whom its success was a personal concern for which they worked zealously. The grants made by the Association in the year showed an increase of £4,210 over the previous year. The amount spent on helping beneficiaries in other ways had also risen considerably. The voluntary income of the Association had only increased by £2,459, however, but it was gratifying that a fair part of this increase came as a result of associate members promoting themselves to the higher subscription grade of full member, paying £1 a year or more. The E.I.B.A. was in a sound financial position. But it was a dynamic soundness, resulting from the success of sustained, and increased, efforts to keep ahead of ever-growing demands for the Association's services. It would allow of no slackening of endeavour on the part of the many helpers of the E.I.B.A.; in fact it would need still more helpers in the current year.

Mr. H. A. Deacon was re-appointed as chairman of the Court, and Mr. R. H. Coates and Mr. Ernest Long were elected as additional members. There were appointed as additional members of the Welfare Committee Messrs. C. B. Cleland, R. W. Holledge and P. G. Wallis.

Mr. M. R. Neville proposed a vote of thanks to the Institution of Electrical Engineers for the use of its Council Room for the meeting.

French Electric Railway Opened

Electric traction was formally inaugurated on the railway line from Valenciennes to Thionville, France, a distance of 170 miles, on 29th June. The line, linking the coalfields in the north with the Lorraine iron centre, carries very heavy goods and mineral traffic. It is the first main line to be fed directly at 25 kV from the French grid system.



C.E.A. Research Facilities

Extensions to Leatherhead Laboratories Opened by Lord Citrine

ON 5th July Lord Citrine, chairman of the Central Electricity Authority, officially opened new extensions to the Authority's Research Laboratories. These consist of a second wing to the existing building, which was originally opened by Lord Citrine almost exactly five years ago, and as a result of the extra space it has been possible to reorganize the work to promote greater efficiency.

The primary function of the Laboratories is to assist in the solution of any of the manifold problems which may arise in the generation, transmission and distribution of electricity. These problems usually have their origin in breakdowns in service or in operational difficulties, and the immediate object of the research is to find a cure for the trouble as quickly as possible, and in general to improve the efficiency and reliability of the electricity supply. Such work, however, often provides the "raw material" for research of a more fundamental nature and the results of this may in turn be applied to practical operation.

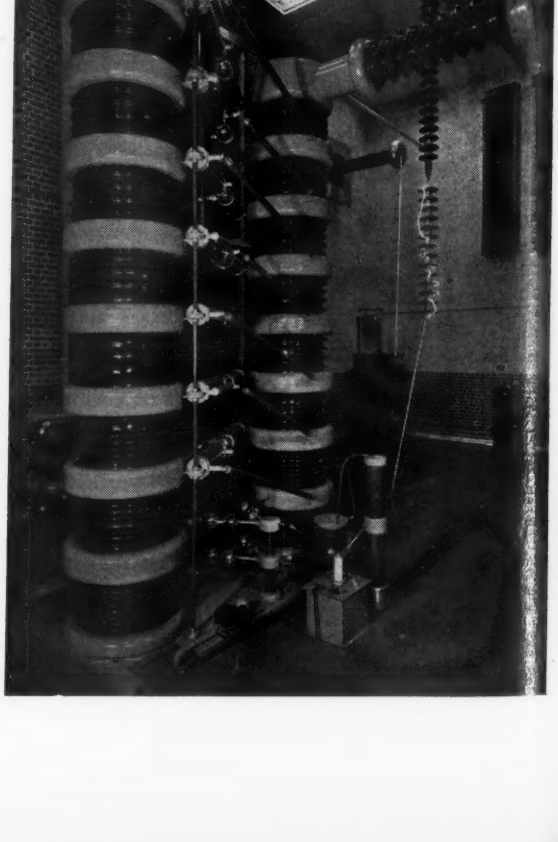
In view of the wide scope of this work, the organization is based on the following six subject sections: transmission and distribution, electronics and instruments, generation, mechanical engineering, physics, and chemistry. There are also photographic and general services sections, a drawing office and a central workshop which provide common services for the laboratories, and a library, reading room and conference room. It is evident that detailed investigations cannot be made in all parts of such a wide field, and close co-operation is therefore maintained with other national bodies, research associations, universities, engineering institutions, etc.

The transmission and distribution section is concerned with research in connection with the design and operation of the 132 kV and 275 kV grid transmission systems and also the distribution networks of the Electricity Boards. A large proportion of the work consists of investigations on insulators and the study of insulating materials. Equipment in the high voltage laboratory provides impulse voltages up to 1,400 kV peak, power-frequency voltages up to 250 kV r.m.s., and d.c. voltages up to 200 kV. Cathode-ray oscillographs are installed for recording impulse and power-frequency waveforms, while power factor measurements can be made up to 250 kV r.m.s. by means of Schering bridges and compressed gas condensers. All the apparatus controls are built into a control desk, and the operator is protected by a screen glazed with toughened glass panels, and provided with electrical interlocks on the doors which give access to the high-voltage area. The controls for the lighting and the overhead runway are also mounted on the control desk. A feature of the control desk is that the instrument pointers and scales are treated with fluorescent paint and illuminated with ultra-violet light, so that the instruments can be read when the laboratory is in darkness. The high-voltage laboratory has a gallery, protected by a screen glazed with toughened glass, from which tests can be observed in safety.

Three laboratories are provided for low-voltage work; one, adjacent to the high-voltage laboratory, for general electrical research, another for work on dielectrics, and the third for investigations on electrical plant and heavy-current tests.

On open ground near the laboratories an experimental high-voltage transmission line has been erected. It con-

1·4 million volt impulse generator discharging across insulator string in the high-voltage laboratory



sists of two 1,200ft spans of conductor supported from special steel gantries 120ft wide. The phase separation and the disposition of the earth wires can be varied to allow the line to be used for investigations at voltages of from 250 to 500 kV (between phases). The normal phase separation is 32ft 6in and provision is made for various arrangements of single and twin conductors. Two earth wires 49ft apart are strung 20ft vertically above the phase conductors. The line insulation normally consists of cap-and-pin units, the string length being altered when necessary to suit the voltage being used. Measurements are made at 275 kV and 380 kV to ascertain the power loss due to corona and insulator leakage in various weather conditions. The radio-interfering field from the line is also being investigated. The mechanical performance of the line is being studied, and vibration-recording devices are attached to the conductors. Meteorological instruments giving continuous records of air temperature, humidity, rainfall and rate-of-rainfall are installed at the experimental line site.

Outdoor testing equipment is installed at Croydon so that life tests can be made on insulators at voltages up to 250 kV under conditions closely simulating those of actual service in industrial districts. Line insulators are suspended from special test towers, and other types of insulator and equipment are erected at ground level on gantries and test racks. The performance of the insulators is under continuous supervision by means of instruments which record the leakage current and count the leakage current surges. Work is in progress on insulators with semi-conducting ceramic glaze, oil-bath insulators, new insulating materials, and methods of washing insulators with the lines alive.

Electronics and Instruments

The work of the electronics and instruments section includes the development of special instruments and the adaptation of new electronic techniques to power system operation. Work is in progress on v.h.f. radio communication, interference with television and radio reception, thunderstorm recording, fault recording instruments, system protection, and load-controlling devices. The laboratory is equipped with various types of cathode-ray and Duddell oscillograph, harmonic analysers, frequency meters, apparatus for noise and vibration measurement, time interval meters and other instruments for radio- and audio-frequency measurements. A specialist workshop equipped for the production of electronic instruments designed in the laboratories is attached to the section.

The section also provides an instrument service for the laboratories; this involves the storage, issue, and maintenance of about 800 instruments. Many investigations have to be made in the field, in switching stations or power stations, and for this work a mobile laboratory with a photographic dark room trailer is available.

The generation section was established to study special generating plant problems, such as vibration, rotor winding failures, the performance of water-cooling towers, and electrostatic precipitation. Work has been concentrated on the last two subjects. An experimental water-cooling tower has been erected at Croydon to permit tests to be made under carefully controlled conditions on various designs of packing, water distribution systems and spray eliminators. The water rate and the air rate can be varied, and any water carried over by the air can be collected and measured. Work is also done on full-scale cooling towers. Two pilot plants for the study of the fundamental mechanism of electrostatic precipitation have been installed: a tubular-type precipitator at Leatherhead and a plate-type operating on the flue gas at Croydon "B" station.

Electronics and instrument laboratory

The work of the mechanical engineering section includes the measurement of the ultimate tensile strength of overhead line conductors and joints, the study and assessment of conductor deterioration, and the testing of materials in general. Research is also carried out on the vibration and fatigue strength of overhead line conductors and turbine blading.

A special 12-ton testing machine is available for measuring the ultimate tensile strength of 10ft lengths of overhead line conductor and the associated joints. For more general work on materials, a 50-ton universal machine, a 150-ton compression machine, an Izod impact tester, two small 2-ton hand machines, and hardness testing equipment are provided.

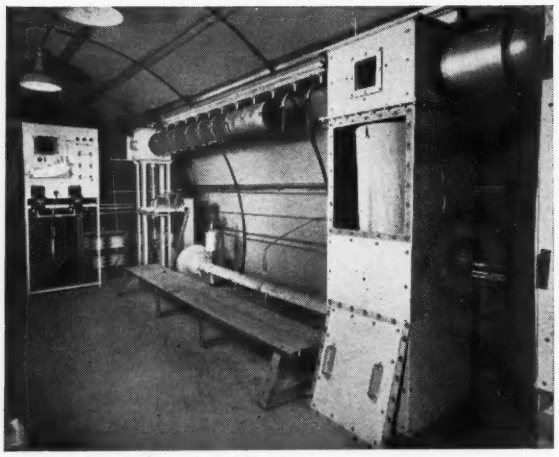
The central workshop is equipped with the usual machine tools which are required for the production of prototype apparatus designed in the laboratories. Woodworking machines and equipment for oxy-acetylene and electric welding are also installed.

Physics Section

The physics section is concerned with general physical problems such as flame radiation, heat transfer, fluid flow and particle-size analysis. Investigations are also in progress on semi-conducting ceramic glazes, particularly in connection with the improvement of insulator performance. Nuclear power problems and fuel cells are studied. The physics laboratories consist of a general physics laboratory and separate laboratories for particle mechanics, light, heat, radiation, X-ray diffraction and radiography.

The radiographic laboratory is equipped with a 140 kV X-ray set. The operators and persons in the surrounding rooms are protected by sheet lead in the floor and doors, and by barium concrete block walls. The doors are electrically interlocked, and the X-ray equipment is operated from an adjacent control room. The control panel is mounted beside the lead glass observation window in the control room. Equipment for gamma-radiography is available.

Meteorology is important in many aspects of power system operation. The demand for electricity is affected by the air temperature, the wind speed, and the daylight intensity. Breakdowns on overhead lines may be caused by thunderstorms, gales, ice and pollution. The corona power loss on the highest voltage lines depends on the rain-



Electrostatic precipitator pilot plant

fall. Accordingly a meteorological laboratory has been provided and equipped with instruments to give weather data of interest in other investigations. A workshop is also attached to the physics section.

The work of the chemistry section includes research on fire-side deposits in boilers, the corrosion of steels at high temperatures, the corrosion of overhead line conductors and underground cable sheaths, and various problems in metallurgy and ceramics. Work is also carried out on insulating and lubricating oils, and apparatus is available for accelerated oxidation tests and for assessing the effectiveness of anti-oxidants in oils. In addition the section provides an analytical service for other sections and also develops special analytical methods for routine use in power stations.

The chemical laboratories consist of a general analytical laboratory and a physical methods laboratory equipped with a Hilger large spectograph, a polarograph, a photo-electric absorptiometer and a flame photometer. In addition there are separate specialist laboratories for corrosion and metallurgy, oil, and ceramics.

Modern Slurry Firing

THE National Coal Board has successfully completed an experiment in burning low grade fuel which may result in considerable savings in cost and release better grade coal for the market. It has used a new type of automatic mechanical stoker to burn slurry—fine particles of coal and soluble shale which is rejected from washeries.

Known as the Martin stoker, the new equipment, which is of German design, has been adapted and installed at Llay Main Colliery in North Wales, where it has been consuming about 650 tons of slurry a week; this has replaced the 450 tons of washed small coal previously used to raise steam in water-tube boilers with chain grate stokers and hand-fired Lancashire boilers.

The fuel is taken from a pond by mechanical grab, loaded into wagons, transported over a weighbridge and transferred into a vertical-sided 60-ton bunker. At the base of the bunker are screw feeders with disintegrators mounted at the delivery end to break up the fuel before it passes down a wide feed chute. On entering the combustion chamber the fuel is sprayed on to the fire bed by air jets; the fire grate is inclined and incorporates reciprocating fire bars which agitate the fuel as it travels to the lower end to be discarded as ash. Slurry has a high moisture content which makes it difficult to spread; there must therefore be constant movement among the particles so that the fuel bed is continuously broken up. This combustion system ensures that hot fuel is continuously mixing with incoming coal and wet material, and even in the winter when ice and snow were mixed in with the slurry there were no ignition difficulties.

It has also been proved that the Martin stoker can deal with a fluctuating load. The fuel bed can be banked-down for as long as two or three days, and steam can then be raised quickly, merely by starting up the fans and feeding fuel to the grate. The new plant went into operation on 9th January and has been in routine operation ever since. By 1st June it had steamed for about 3,000 hours, burnt about 14,000 tons of slurry and carried about 40 per cent of the regular colliery steam load. The installation cost £130,000, and includes a 50,000 lb/hr water-tube boiler and accessories, the Martin stoker, coal and ash handling plant, feed-water treatment plant and other auxiliary equipment. Further installations are being considered, and one is under construction at Bowhill Colliery in Scotland.

Automatic Noise-Factor Meter

IN the *Transactions* of Chalmers University of Technology, Gothenburg, Sweden (No. 161; 1955), details are given of an automatic noise-factor meter which has been described in a paper by Henry Wallman. The new meter is an automatic form of the "3 dB attenuator plus post-amplifier" method of noise-factor measurement.

As in the manual post-amplifier method, the basic idea consists of supplying the amplifier under test with noise from a noise diode adjusted so as to make half the sum of the noise from the amplifier under test plus the amplified noise from the noise diode equal to the noise from the amplifier alone. When this is the case, the noise-power contribution of the noise diode is clearly equal to that of the amplifier. The usual assumption is then made that the noise power delivered by a noise diode is proportional to its d.c. anode current. This leads to the result that the noise factor of the amplifier under test is proportional to the noise-diode anode current. With a suitable constant of proportionality, the milliammeter indicating this anode current then reads directly in noise factor in the standard way. In the particular case in question the adjustment of the noise diode is carried out automatically and at the rate of 50 times per second.

A servomechanism fulfils the purpose of adjusting the temperature of the noise-diode filament to the correct value by seeking to reduce to zero the square wave at the output of the 3 dB attenuator which represents the difference between amplifier noise and half the amplifier noise plus the noise-diode noise.

The method is clearly a null method which has the essential advantage that the only source of systematic error of any importance lies in the calibration of the 3 dB attenuator, under the single assumption that the loop gain is high. As is the case with the manual post-amplifier method, it does not matter whether the detector is quadratic, linear, or something in between. Neither the amplification of the amplifier under test nor of the measurement apparatus itself need be stabilized. The indicated noise factor is, furthermore, not dependent on the calibration of the ratio of two electrical quantities.

The noise-factor meter is a single-loop servomechanism, the fundamental variable being the noise-diode anode current, since this current is proportional to the diode noise power and thus to the noise factor. The loop gain is thus the current amplification rather than the power amplification of the loop, even though the noise factor is a ratio of two powers.

The servo is not linear and the current amplification is far from constant. The current loop gain was measured and it was found that 5 mA was a typical value of the noise-diode anode current for a 2,000 times amplification. This value pertains to a deviation from balance of 1 mV at the mixer tube feeding the noise-diode filament. For 10 mV deviation the loop gain is smaller, in consequence of the non-linear characteristic of the amplifier.

WORLD ELECTRICAL MARKETS

South African Survey

By W. L. SPEIGHT

SOUTH AFRICA can be regarded as a country in an advanced state of electrification, and while some of its needs in domestic appliances, industrial motors and certain other lines, such as cables and lamps, are being supplied by local industry, most of the heavy generating and other plant must be imported. Much of that at present in use is of British manufacture. The largest single electricity authority in South Africa is the Electricity Supply Commission, whose successive annual reports have revealed steady increases in the output of its power stations.

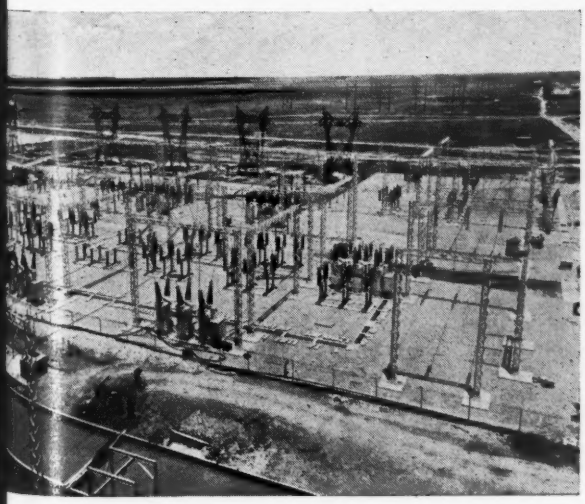
The Commission is now producing about 10,000 million kWh a year; 80 per cent of the output goes to the railways, mines and industries, and the balance is used by scores of local authorities, farmers and smallholders. While the extension of rural power represents only a small part of the Commission's activities there are a number of schemes under way or planned to widen the scope of rural electricity and the provision of plant for farms and smallholdings will provide a regular market for the manufacturer. During the past few years the Commission has been a large purchaser of British generating plant, but with a great part of the current construction programme completed or nearing completion it may be some time before further major orders are placed.

The West Bank No. 2 power station at East London will not be ready as a combined unit until near the end of this year. Extensions are still under way at the Ungeni power station on a third 30,000 kW turbo-generator. The Taaibos station construction is well advanced and work has gone ahead on other new power stations. While increasing demand may lead to the extension of some of the existing power stations the Commission is not at present planning any new major construction work. Most of the railway electrification schemes have also been completed and no further major schemes are envisaged.

In spite of all this both the railways and the Electricity Supply Commission remain important customers for a very wide range of electrical manufactures. South African industry is providing a considerable proportion of these needs but the rest must be imported. Since International Combustion Africa, Ltd., and Babcock & Wilcox established their large factories, it has been possible for local industry to supply steam raising and other power plant, but that has not ended the importation of a wide range of boiler plant for power stations.

Most of the large municipalities still retain their own power undertakings, sometimes running these under a pooling arrangement with the Commission. Johannesburg has been engaged in the building of its new Kelvin power station and in the very near future Cape Town will have to construct a large power station to provide for the growing load in the city. Smaller municipalities have been raising loans, or are about to do so, for the provision of power plants.

The Electricity Supply Commission's new Taaibos power station near Coalbrook, O.F.S., where seven 60,000 kW turbo-alternators and 580,000 lb/hr boilers are to be installed. Below: B.T.H. 132 kV, 3,500 kVA oil circuit-breakers at Taaibos



In both Cape Town and Johannesburg there has been consideration of a suggestion that the new power stations should not be fuelled by coal but should be supplied with nuclear heat. In both cases the proposal has been investigated carefully by the city electrical engineers and advisers, and in both cases the recommendations have been against "atomic" power stations. While it is quite likely that sooner or later such stations will be established in South Africa, for many years to come the demand will be for generation and other equipment of the present type.

South African imports of electrical machinery and apparatus naturally vary from year to year, rising to a peak when the major electrification schemes are under way, but in an average year at least £21,000,000 is spent on the importation of generators, motors, etc., batteries and

accumulators, lamps and tubes, apparatus for telegraphy and telephony, cables and wire, and other electrical manufactures. Of this total about £14,000,000 is spent with British firms, with the United States as the second most important supplier. In recent years German exports of electrical manufactures to South Africa have been increasing, and as German quotations are always competitive it seems possible that the future will see British manufacturers facing more and more keen competition from this source.

Much of the American trade in electrical goods in South Africa has been in the domestic sphere, and there does not seem to be any likelihood of the American refrigerator or the Canadian electric cooker losing its hold on the South African market. Both American and British washing machines have been selling well in the South African market. This has absorbed both the very expensive models, with spin dryers and other refinements, and the simpler but effective machines.

British cookers, kettles, toasters and other domestic electrical appliances are well established in South Africa, meeting well the competition from the local industry, which is now producing a wide range of cookers, heaters, kettles, toasters and other devices of high quality at competitive prices. This local industry is now well established but it has not in any way ousted the British product of similar type and does not seem likely to do so.

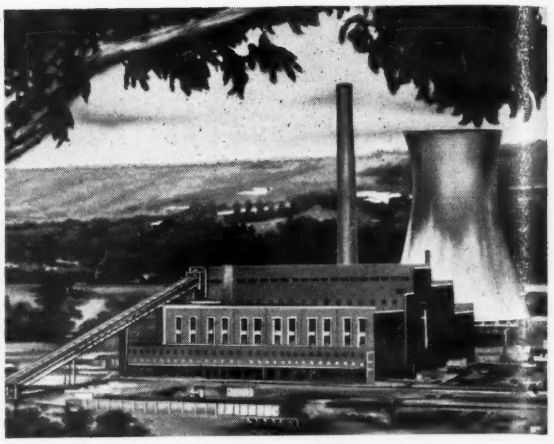
The one department in which the import outlook is not encouraging is in all descriptions of electric cables. Several factories are now operating in the Union, most of them with close British connections, and they are producing the bulk of South Africa's cable needs, with a large surplus available for export to neighbouring territories and even at times to consuming centres much further afield.

While at least one cable factory was operating in South Africa before the war, the manufacture of electric lamps in the Union is a more recent development. Increasing quantities are being made locally, but there is still a big importation of various descriptions of lamps made in Britain. It does not seem that local manufacture will be able to meet local needs for a long time to come.

Transformers, motors and similar electrical equipment have now been made in South Africa for several years, together with switchgear and other apparatus, but while this production is comprehensive it is far from meeting all the variety of needs in this market. Roughly there are five different groups of consumers in South Africa, each with its own specifications for transformers, etc., so that it has not been possible to standardize such items in South Africa. There are now five manufacturers in South Africa of power distribution transformers. The First Electric Corporation of South Africa, Ltd., for instance, is making transformers of up to 5,000 kVA and it is planning to extend its range up to 10,000 kVA. Asea Electric South Africa (Pty.), Ltd., can build to the most modern designs by the latest methods transformers up to about 3,500 kVA for voltages up to 44 kV. Aberdare Electric Africa, Ltd., has made transformers for new power stations, and Switchgear & Erection Co. (Pty.), Ltd., are making transformers to Brush designs.

British Representation

Most of the large British manufacturers of electrical plant and other machinery are represented in South Africa by agents who have been established in the trade for many years, and even when some of these big British companies have opened branch factories in the Union, as a number of them have done in recent years, they have still been content to leave selling in the hands of these well-established representatives. These firms are usually the sole agents



The first 30,000 kW set at Umgeni power station, near Pinetown, Natal, was brought into commercial operation in June, 1954

in Southern Africa for the manufacturers concerned. They are well equipped to keep their principals informed of important developments in local electricity undertakings, so that they will be in a position to tender in good time. Some of these representatives carry considerable stocks of small electric motors and other equipment, but sales of larger equipment are furthered with the aid of trade catalogues and other literature provided by the parent firms. In the case of large generating plant construction is frequently undertaken to specifications finally agreed upon after several consultations between the purchasers in South Africa and the British manufacturers, often under the guidance of consulting engineers, but the preliminary negotiations may be opened with the representatives in South Africa.

The Mining Industry

Among the important consumers of electrical manufactures in South Africa are the gold and other mines. In spite of the rise of coal and other base mineral mining in South Africa, the gold mining industry remains supreme as mining consumer of electrical manufactures, especially now that a large number of these mines are also uranium producers.

While it is unusual for gold mines on the Rand or in the Orange Free State to generate their own power, as this is largely supplied by the Electricity Supply Commission, large quantities of transformers and other equipment are sold to the mines annually to handle the vast load, and it is largely due to the awareness of the keen agent regarding the day-to-day needs of the large mining companies that the manufacturers he represents can look back on a succession of satisfactory sales to mining corporations. So far as possible the mining companies purchase their requirements from local manufacturers, but their demands are so varied and so exacting that it is not always possible to satisfy them from South African production. Many British electrical machinery manufacturers have long been suppliers to the South African gold mines and there is no reason to suppose that this trade will suffer an early decline.

The latest Budget speech of the Minister of Finance has revealed a healthy economic state in South Africa and future prospects appear to be encouraging. While the South African market for all types of electrical goods, from large turbo-generators to small domestic appliances, will remain severely competitive, it will continue to offer excellent business opportunities to the British manufacturer.

The Union Government will certainly buy electrical machinery in the most promising market, but so much heavy British electrical machinery has been installed in South African power stations, where it has certainly proved its sterling value, that British manufacturers may again be preferred when further orders have to be placed.

Some time ago there were complaints of long delays between the placing of orders and the eventual delivery of the machinery, but most British firms seem to have overcome these difficulties now, and if they can in future promise delivery in a reasonable time and in the main adhere fairly closely to these delivery dates satisfactory business should flow their way. German and other Continental manufacturers are also keenly interested in the South African market for electrical goods, so that the British manufacturer will have to keep in close touch with local developments to be able to cater for important needs as they arise.

International Electrotechnical Commission

Banquet at the Guildhall

AT a banquet to the International Electrotechnical Commission at the Guildhall, City of London, on 5th July, when Sir Roger Duncalfe, president of the British Standards Institution, was in the chair, the principal speaker was the President of the Board of Trade, the Rt. Hon. Peter Thorneycroft, M.P. In welcoming the Commission, he said we were living in a day and age when the work of the Commission assumed a peculiar importance. Human progress was not a steady, even process. For long periods it remained virtually static; at others it surged forward at a pace which caught the spectators by surprise, and we might be at such a stage now when we were facing a combination of factors which were likely to bring about alterations in our standard of living at least as dramatic as any past revolutionary events.

On the one hand we had the development of atomic power and on the other the development of a complex of processes which brought the automatic factory within the bounds of possibility. This combination of new power and new techniques would bring about an industrial revolution in the second half of the century. It was clear that the years which lay ahead would bring untold and still unrealized opportunities, and it must be a source of some satisfaction to the Commission that the work which they were carrying through in the field of common standards and the removal of artificial barriers to trade had done so much to bring forward the favourable situation of to-day.

All the nations were going to be faced with the same kind of problems and it would be tragic and indeed fruitless if they tried to stave off the industrial revolution. There was much that the nations could do in co-operation. The agreement recently reached between this country and the United States of America in the field of civil use of atomic energy and the fact that both were helping other countries in these matters were examples of the kind of co-operation he had in mind. Co-operation within the factory was no less important, as Sir Walter Monckton had stressed the other day at Geneva. A worker brought part of his life to a factory and the main object of human relations policy was to create a confidence which allowed men to work together with a common approach to common problems.

A large part of the exciting events which were now unfolding lay firmly in the field of the research worker, the technician, the industrialist, the trade union official and, last but not least, of the financial institutions who would have the immense responsibility of finding capital for these developments. And the role of the Governments was to create the conditions in which those great changes could go smoothly forward.

The conditions of the 1930's did not persist to-day. If the eyes of Governments or industry or trade unions were fixed upon the problems of 20 years ago and if their outlook and policies were shaped by the constant fear of a slump rather than the hopes of sharing in the revolutionary changes which lay ahead, then they would move backward and not forward. The prizes of this world would go to those who showed more courage in these matters than ourselves. But was that not the atmosphere he sensed about him. Whether it was in London or in Paris, in Geneva or in Washington, he sensed that all intended to go forward. There was indeed much that all could gain and much more that all could give to the generations to come.

Other speakers at the banquet were Viscount Waverley, the Lord Mayor of London (Sir Seymour Howard) and the president of the International Electrotechnical Commission, Dr. H. S. Osborne. It was announced at the banquet that Dr. P. Dunsheath, C.B.E., M.A., M.I.E.E., director, W. T. Henley's Telegraph Works Co., Ltd., had been appointed president of the I.E.C. for the next period of office.

Charles Le Maistre Memorial Lecture

At the Royal Institution last week the International Electrotechnical Commission held the first memorial lecture commemorating Charles Le Maistre, their general secretary for forty-nine years.

M. André Lange, who delivered the lecture, is a French electrical engineer of great distinction and knew Mr. Le Maistre well throughout his life. He took as his theme, " Charles Le Maistre: his work, the I.E.C.," and described how the standardizing work of the Commission over the last half century had owed much of its drive to his immense ability in stimulating co-operation among men of varying ideas.

M. Lange was thanked by Professor de Artigas, of Spain, and General Wiener, of Belgium, on behalf of the members present, and Dr. Dunsheath presented him with a silver salver as a memento of the occasion.

Public Transport Association

The annual dinner of the Public Transport Association is to be held at Grosvenor House, Park Lane, London, W.1, on Thursday, 10th November. The Minister of Transport, Mr. J. Boyd-Carpenter, has accepted an invitation to attend as the principal guest.

PARLIAMENTARY REPORT

Scientists and National Service

In a House of Lords debate on National Service exemptions, Lord Glyn said that although coal miners, agricultural labourers and men serving in the Merchant Navy were given exemption, British industry was finding it increasingly difficult to get the technologists who were required to maintain the country's position in the competitive world markets. Those who were being trained had great difficulty in maintaining their courses of study when they had to leave at a critical time to carry out their National Service obligations. He did not suggest that total exemption should be granted, but the Service Departments should consider whether there was any alternative form of service which they could undertake so that they would make their contribution in such a manner that it would not interfere with their progress and study as much as it did at present.

Lord Cherwell said it would be ludicrous if a young man could escape his National Service by signing on as a cabin boy or mess waiter on an Atlantic liner. Surely it must be clear that, from a national point of view, the work of highly-trained scientists was more important. An extreme case was that of the really high-grade research workers in the universities. Here they had young men working on the frontiers of knowledge whose training had cost the State literally thousands of pounds. In case of war they would instantly be drafted into the scientific establishments, nowadays perhaps the most important branch of the Armed Forces. Yet these young men were called up for National Service with the greatest rigour at the most fertile period of their lives, when two years' interruption would very likely do irretrievable harm to their capacity to think out new theories and discover new facts.

Lord Cherwell said that the Government had been urged to give exemption to people carrying out important research but the plan that was approved was so restricted in its scope that not more than 50 of these high-grade scholars could be exempted in any one year—and that only after the most stringent test and vetting and recommendations from all sorts of high authorities.

Lord Carrington, Parliamentary Secretary, Ministry of Defence, replying to the debate, said that the House must not overlook the Services' need for science and engineering graduates to look after the functioning of the complicated equipment now in use. The Forces had a particular need for men with degrees in engineering, physics and mathematics and it was estimated that in 1955 they would recruit rather less than half of what was needed. He could assure Lord Cherwell that the Services tried to use National Servicemen, who were skilled in a particular job, in the job which suited them best.

The scheme for deferring the service of 50 exceptional science graduates who were engaged on fundamental research at the universities annually was a good innovation and Lord Cherwell had, perhaps, poured too much cold water on the idea. It was too early to say how well it was going to work but so far there had not been 50 applications from the universities for deferment under the scheme. A good case could be made out for the deferment of large groups of skilled men in all sorts of industries engaged on exports or defence work, but the fact remained that, for the time being at any rate, the Government must maintain the defences.

Man-Power for Atomic Programme

Sir David Robertson asked the Minister of Works if he was aware that a shortage of scientific man-power was threatening the expansion of the industrial atomic energy programme and what steps were being taken now to attract trained men and women into the service of the Authority and to train promising students for future service.

Mr. Birch, Parliamentary Secretary, Ministry of Works, said there was a nation-wide shortage of certain types of scientists and engineers and the question of how to remedy it was at present under urgent study. The Atomic Energy Authority was doing all in its power to enlist the services of trained men and women in these classes and it encouraged the junior staff to secure higher qualifications by assistance with fees and facilities for study in official time.

Automation and Employment

Mr. Allaun asked the Minister of Labour if he would hold an inquiry, inviting trade union participation, into the effects on employment in this country of a spread of automation, automatic processes, and automatic factories.

Sir Walter Monckton said a good deal of study was already being devoted to the various aspects of this subject and he did not think that there was need for him to hold a special inquiry into the effects on employment.

Duty-free Machinery Imports

Air Commodore Harvey asked the President of the Board of Trade if he would take steps to reduce the present minimum of £2,000 in respect of duty-free imports of machinery to £500. The present minimum was hitting small businesses very hard. If the Government wanted to encourage them it must give them equal facilities to obtain modern machinery.

Mr. Low, Minister of State, Board of Trade, said the matter was closely considered by the Wilson Smith Committee which went into the whole question of duty-free licensing of imported machinery and recommended that there was no other way of limiting the cost of the administration of the scheme than by imposing a comparatively high minimum value. The President of the Board of Trade accepted that part of the report with reluctance because he was aware of the importance of the small business.

Effect of Hire-Purchase Restrictions

Mr. H. Hynd asked the President of the Board of Trade whether he was aware that one firm of electric washer manufacturers in Accrington had had to suspend 90 workers owing to slackness of trade following hire-purchase restrictions and whether his consideration of difficulties caused in the furniture trade would extend to electric washing machines and similar goods.

Mr. Kaberry, Parliamentary Secretary, Board of Trade: "Yes. The Minister is ready to consider representations from anyone about the effect of these restrictions which, in this case, may have been aggravated by the rail strike."

Monopolies and Foreign Competition

Mr. Grimond asked the President of the Board of Trade if he would give an assurance that no industry in which monopolistic or restrictive practices had been criticized by the Monopolies Commission would be afforded protection by tariffs or quotas against foreign competitors.

Mr. Low said that when considering tariff applications, it was their policy to take into account all relevant factors, including any recommendations made by the Monopolies Commission, and he could not prejudge the outcome of a particular application. It was not the Government's policy to impose import quotas for protective purposes.

The Electronics Industry

Mr. George Strauss asked the Prime Minister if it had yet been decided whether the electronics industry should remain under the responsibility of the Minister of Supply or pass to the President of the Board of Trade.

Sir Anthony Eden said that this responsibility would remain for the time being with the Ministry of Supply.

State Scholarships

Asked by Dr. King if he would consider the awarding of a number of additional university State scholarships

in science, tenable by candidates who undertook to teach science on the completion of their university course, the Minister of Education (Sir David Eccles) said he did not think it desirable to make the tenure of any awards for university courses conditional upon an undertaking of this sort.

North Wales Water Power

Moving the rejection of the North Wales Hydro-Electric Bill in the House of Commons last week, Mr. Gerald Nabarro described the hydro-electric schemes at Festiniog and Rheidol, which are authorized in the Bill, as "financially improvident, economically unjustifiable and æsthetically ruinous." The Bill had already been passed by the House of Lords, where is was slightly amended to meet objections raised by parties interested in preserving amenities. After a lengthy debate in which Mr. Joynson-Hicks, Parliamentary Secretary, Ministry of Fuel and Power, rejected the arguments put forward by Mr. Nabarro, and Welsh members welcomed the new opportunities for employment which the schemes would bring, the House of Commons gave the Bill a second reading by 129 votes to 23.

Mr. Nabarro said that the Festiniog scheme would cost £14·79 million and the Rheidol scheme £5·79 million. In the case of Festiniog, which was a pumped storage scheme, the load factor would be only about 11 per cent and that of the Rheidol scheme 19 per cent. The only parallel case for this kind of thing was the Loch Sloy hydro-electric station which worked on a load factor of 10 per cent and was the biggest "white elephant" of any hydro-electric works in the world.

Some members, he said, might think that the sole justification for these extravagant water works in Wales was that a small amount of coal would be saved. When brought to fruition they would save 71,000 tons a year. Thus £290 of capital investment was required in these two schemes to save one ton of coal a year. This meant that, without any interest charges on the capital invested, it would take 60 years to recover, in terms of value of coal economy, the amount of investment. If interest charges were added, it would take more than 100 years.

Mr. Nabarro said he would invite members to oppose the Bill and to support a policy of providing power where it was really needed in the remote areas of rural Wales by means of small diesel stations close to the points of consumption and in the case of peak load requirements by installing auxiliary oil-driven generators in existing power stations. Both alternatives could be furnished at only one-third of the capital cost involved.

Mr. Peter Kirk, who seconded the rejection of the Bill, and other members, opposed it because they considered that the Central Electricity Authority had not met all the objections of those who were anxious to preserve the beauty of the Welsh countryside, particularly in the case of the Rheidol scheme.

Mr. Peter Thomas, the Member for Conway, supporting the Bill, said that following the amendments that had been made there would be little ill-effect on the areas concerned.

Mr. T. W. Jones, the Member for Merioneth, said that the people of Festiniog would be dismayed if Parliament were to reject these schemes which would bring employment to many men who had had to leave the quarries because they had contracted silicosis.

Mr. Joynson-Hicks, replying on behalf of the Ministry of Fuel and Power, as representing the C.E.A., said he had no knowledge of any other hydro-electric schemes in Wales being brought forward at present. Before the House voted it was only fair to consider the Authority's reply to the challenge that had been made on the technical and economic merits of these schemes. That at Festiniog was the largest proposal for a pumped storage scheme in the world and its capacity would be about 300 MW, which was not in itself a very big station but it was a very useful contribution to the production of electricity in the area. The cost would be £14,750,000 compared with £25,250,000 for a 300 MW station burning coal, so that the cost was £49 per kW installed, compared with the accepted current figure for a coal-fired plant of £65 per kW installed. This meant that electricity would cost 0·6d/kWh as against the normal figure for a modern, coal-fired plant of 0·62d. Therefore in capital costs and in unit production costs it was cheaper than a coal-burning station. It had one further great advantage. During the off-peak period it refreshed itself, so to speak, by receiving electricity from the grid when the surplus of electricity was being produced at the base-load stations, using that electricity to pump water back into the upper reservoir so that it had power available at peak hours on the following day to operate its own generators.

"When we advance further and run our base-load stations on nuclear power," he continued, "the immediate advantage will be seen because we shall save the whole cost of the coal which is burnt in order to produce electricity used to pump the water up again. At present that cannot be saved because a coal-fired base-load station has to be kept in operation overnight, but when it is burning nuclear energy the cost of the coal will be saved. The scheme represents the ideal and most beneficial way of using the new method and the old method in harness."

The Rheidol scheme was also unusual because it would use water over a drop of 950ft. It was sometimes thought that the Niagara Falls carried a lot of water down a steep drop very fast and very far, but there the drop was only 120ft and power was generated there in a different way. In this case the drop created many engineering difficulties, and the water had to be passed down three steps; the top reservoir would be 1,100ft above sea level, the middle one 830ft, and the bottom one 150ft, with one station at each level. The first would produce 12 MW, the second 36 MW and the third 1 MW.

Mr. Nabarro had said that the schemes were an equivalent of an expenditure of £290 to save one ton of coal a year, but this was based on the cost of putting up the schemes and the amount of coal saved. That was not the basis of computation at all. It contained a fallacy. It omitted to take into account the fact that the operation was producing electricity. If Mr. Nabarro wanted to produce 350 MW at current rates by coal-fired stations it would cost him £27 million. Therefore the Authority would not only be getting the 350 MW at a cheaper rate but would also be saving that amount of coal. The cost of production in the Aberystwyth diesel plant, cited by Mr. Nabarro for providing peak load electricity, was 1·2d/kWh —double the price by hydro-electric methods.

Energy from Nuclear Stations

Mr. Palmer asked the Minister of Fuel and Power if he would state the approximate relative amounts of electrical energy for public supply likely to be available from nuclear power stations of the Atomic Energy Authority and the Central Electricity Authority at the end of the next five-year period.

Mr. Geoffrey Lloyd replied that the nuclear reactors of the Atomic Energy Authority should have an installed capacity of between 200 and 270 MW and those of the Central Electricity Authority a capacity of between 200 and 400 MW, but it was not yet possible to say what amounts of electrical energy would be supplied.

Power Station Coal

In reply to Mr. Nabarro, Mr. Geoffrey Lloyd said that power stations in Great Britain used 41½ million tons of coal in the year ended 30th June last, of which 3 million had to be imported, and they might use nearly 44 million tons in the following twelve months. The C.E.A. made no direct purchases of foreign coal.

Pension Schemes

Mr. Palmer asked the Minister when he hoped to make a statement on the improvement of pension schemes taken over under the Electricity Act, 1947, and the Gas Act, 1948, which now provided inadequate benefit in relation to living costs.

Mr. Geoffrey Lloyd said that consultations had been unavoidably prolonged but he hoped to be in a position to make a statement soon.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

At a meeting of the Council of the International Electrotechnical Commission held at British Standards House on Friday afternoon, 8th July, **Dr. Percy Dunsheath,** C.B.E., M.A.(Cantab.), D.Sc.(Lond.), D.Eng., M.I.C.E., M.I.E.E., was unanimously

The retiring president of the International Electrotechnical Commission, Dr. Harold S. Osborne, with the new president, Dr. Percy Dunsheath

elected president of the Commission, to succeed **Dr. Harold S. Osborne,** whose three-year term of office had expired. Representatives of the 25 nations who had been attending the 1955 session of the I.E.C. in London were present at the Council meeting when Dr. Dunsheath was elected.

Dr. Dunsheath has been chairman of Convocation, University of London, since 1949. He is a director of several electrical concerns and a member of the London Electricity Board. He is a past-president of the Electrical Development Association, the Institution of Electrical Engineers, and the Association of Special Libraries and Information Bureaux, as well as a past-chairman of the London Regional Academic Council, the F.B.I. Education Committee, the Special Committee on Shortage of Science Teachers and the Woolwich Polytechnic Governors. He was the leader of the productivity team to the United States (1951) to study relations between American universities and industry.

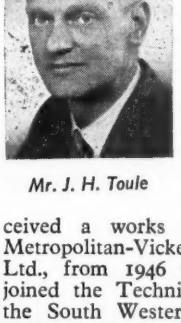
A lecturer and writer of books and articles on scientific, technical, and educational subjects, Dr. Dunsheath has been closely associated with the International Electrotechnical Commission for the past 30 years and served as hon. secretary of the Commission for some years, and subsequently held office as hon. treasurer for nine years.

The Ministry of Supply announces that **Dr. R. Cockburn,** C.B., O.B.E., has been appointed deputy controller of electronics in succession to **Rear Admiral G. Burghard,** C.B., D.S.O. (Retd.), whose tour of duty has expired. Dr. Cockburn has been principal director of scientific research, guided weapons and electronics, since March, 1954. Before that he was scientific adviser to the Air Ministry.

Capt. K. H. T. Peard, R.N., is to succeed Rear-Admiral Sir Philip Clarke as director of the Naval Electrical Department, with the rank of rear-admiral, as from 17th August. Capt. Peard commanded H.M.S. *Collingwood,* the naval electrical training school, from 1953 to last January.

Mr. S. E. Jennings has been appointed area manager for Scotland and North East England of the Gramophone Co., Ltd., and **Mr. P. H. Evans** has been appointed area manager for North West England and North Wales.

Mr. J. H. Toule, who writes in this issue on current transformers, received his technical education at University College, Nottingham. He was with the Lincoln Corporation Electricity Department in 1939-40 and then served in the Royal Engineers as captain, being demobilized in 1946. He received a works training with the Metropolitan-Vickers Electrical Co., Ltd., from 1946 to 1948 and then joined the Technical Department of the South Western Division of the British (now Central) Electricity Authority as assistant in 1948. Since 1950 he has been regional engineer of the Bristol Region Technical Department of the same Division.



Mr. J. H. Toule

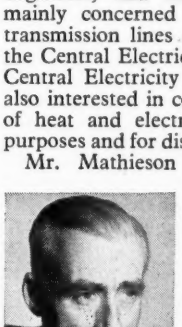
Councillor J. Cottenham is the first Mayor of Enfield following its recent "promotion" from the status of urban district to that of borough. Mr. Cottenham is chief patrol officer at the Brimsdown factory of the Edison Swan Electric Co., Ltd.

Travelling scholarships for 1955 (value £50) have been awarded by the **Worshipful Company of Tinplate Workers** to the following:—Mr. P. M. M. Boucher, employed by the Metropolitan-Vickers Electrical Co., Ltd. (award presented by the British Electrical and Allied Manufacturers' Association); Mr. G. Catley, employed by Standard Telephones & Cables, Ltd. (presented by the Cable Makers' Association); Mr. K. Collinson, International Combustion, Ltd. (presented by the Water Tube Boiler Makers' Association); Mr. D. R. Jobson, W. T. Henley's Telegraph Works Co., Ltd. (presented by the Cable Makers' Association); Mr. V. J. Millar, Yarrow & Co., Ltd. (presented by the Water Tube Boiler Makers' Association); Mr. B. Pounder, Enfield Rolling Mills, Ltd. (presented by the Cold Rolled Brass and Copper Association); Mr. C. A. Price, Guest, Keen Iron & Steel Co., Ltd. (presented by the Electrical Trades Union); Mr. T. Prescott, British Insulated Callender's Cables, Ltd. (presented by the Cable Makers' Association); Mr. J. F. Thompson, Yorkshire Electricity Board (presented by the Electrical Trades Union); and Mr. A. Waites, Yorkshire Copper Works, Ltd. (presented by the Brass and Copper Tube Association).

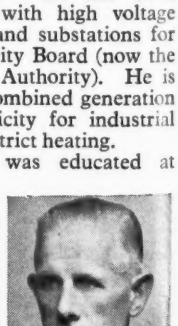
Mr. Bryan Donkin, B.A.(Cantab.), M.I.E.E., M.Am.I.E.E., M.Soc.C.E. (France), has accepted the invitation of the Executive Council of the Association of Supervising Electrical Engineers to continue as president for a further term. The new national chairman of the Association is **Mr. R. F. Mathieson,** Associate I.E.E., London manager of the Electrical Apparatus Co., Ltd.

Mr. Donkin is a partner in the firm of Kennedy & Donkin, consulting engineers, and his work has been mainly concerned with high voltage transmission lines and substations for the Central Electricity Board (now the Central Electricity Authority). He is also interested in combined generation of heat and electricity for industrial purposes and for district heating.

Mr. Mathieson was educated at



Mr. Bryan Donkin



Mr. R. F. Mathieson

Clydebank High School and the Royal Technical College, Glasgow, and served his apprenticeship with Electric Control, Ltd., Glasgow. From 1928 to 1934 he was a sales engineer with Allen West & Co., Ltd., and subsequently held similar positions with the E.M.B. Co., Ltd. (1934-36), and the Midland Electric Installations Co., Ltd. (1936-38), before joining the Electrical Apparatus Co. He has lectured to many branches of the A.S.E.E. on motor control gear and has written "The Control Gear Handbook," which is being published by the Electrical Apparatus Co. He was a member of the organizing committee of the first two Electrical Engineers' (A.S.E.E.) Exhibitions, and is a member of the I.E.E. Informal Meetings Committee.

Col. H. P. Thornley, managing director of J. & H. McLaren, Ltd., a Brush Group subsidiary, is relinquishing his post on 27th August to join the staff at the group headquarters in London. His new appointment will be director of administration and supply. He will be directly responsible to Mr. Miles Beevor, managing director of the Brush Group, Ltd.

Mr. Dennis Freedman has been appointed to the board of the Kenwood Manufacturing Co., Ltd. Mr. Freedman joined the company in 1950.

After more than thirty years with the British Broadcasting Corporation, **Mr. Stanley A. Williams,** M.B.E., engineer-in-charge of the B.B.C.'s radio station at Skelton (Cumberland), is to retire. Mr. Williams took charge at Skelton in 1942 and spent several months in 1951 in charge of a broadcasting station in South Johore, Malaya.

Mr. Kevin Hughes, who has been with Goodmans Industries, Ltd., for nine years, has now been appointed a director of the company.

Mr. A. Wright has been appointed secretary to Rashleigh, Phipps & Co., Ltd.

The seventh annual sports meeting of the **Telcon Social and Athletic Club** was held at the Kidbrooke Sports Ground on 9th July when a large gathering watched over thirty events in brilliant weather. Competitors came from the company's works at Crawley, Sussex, and Farnborough, Kent, and also from the new Ocean Works of Submarine Cables, Ltd., at Erith.

The Sir Geoffrey Clarke Challenge Cup, the premier award of the meeting, was won by the General Office (Greenwich Works) with the Engineering and Plastics Divisions tying for second place. The prizes were presented by Mr. J. N. Dean, chairman of the Telegraph Construction & Maintenance Co., Ltd., and Submarine Cables, Ltd., while the successful competitors were introduced by Dr. G. A. V. Sowter, chairman of the Club's General Purposes Committee. Others present included Mr. W. F. Randall, Dr. E. W. Smith and Mr. J. Innes, C.B., directors of Telcon, and Mr. G. T. W. Whitehead and Mr. C. W. Bishop, of Johnson & Phillips, Ltd.

The Eastern Area final of the **E.I.B.A. National Golf Competition** was played off at the Thorpeness Golf Club on 6th July. The winner of the Windibank Cup was Mr. C. E. Goldsmith, of Colchester, Mr. H. Harrup, of Gorleston, being runner-up. The best scratch score was returned by Mr. C. O. Smith.

The South West Area finals were held at Yelverton Golf Club in perfect weather on 5th July; there were twenty-four competitors. The Medal Trophy was won by Mr. A. H. Warren, of Bodmin, and the runner-up was Mr. F. G. Rowse, of Plymouth. The afternoon's Stapleford match was won by Messrs. Vercoe and Jones, of Saunton, North Devon. At the prize-giving and dinner at the club, Mr. W. J. Oxenham (manager, West Devon District, South Western Electricity Board), who presented the awards, read a telegram of good wishes from Mr. H. Senior Fothergill.

The usual monthly luncheon of the **Electrical Industries Club** was held at the Connaught Rooms, London, on Tuesday when Mr. Tom O'Brien, M.P. (Trades Union Congress) addressed the gathering in a mixture of serious and humorous vein on broad lines covering world and human relations.

An informal cocktail party was held on 7th July at the Farcroft Hotel, Birmingham, by Rowlands Electrical Accessories, Ltd., when Mr. Scott Adie (chairman) presented **Mrs. Winnifred Lawrence,** lady supervisor, with a silver fruit dish and a cheque to commemorate the 25th anniversary of her appointment.

The Dowager Lady Swaythling, O.B.E., president of the Electrical Association for Women, gave a tea party for the wives of the chief delegates to the International Electrotechnical Commission. Among the countries represented were Canada, the United States, France, Switzerland, Germany and the United Kingdom.

The annual dinner of the **Cromptonian Association,** which was postponed owing to the railway strike, will now be held on Friday, 30th September next.

OBITUARY

Mr. J. J. Conlan.—Many people in the industry will have heard with regret of the death on 6th July of Mr. James J. Conlan, who was a member of the staff of the British Electrical and Allied Manufacturers' Association for many years. Mr. Conlan was head of the Publicity and Statistical Departments and his many activities included the editorship of the *BEAMA Journal,* membership of the B.E.A.M.A. Electricity Development and Publicity Committees, representation of the B.E.A.M.A. on the ASLIB Fuel and Power Group Committee, the B.S.I. Committee on the Standardization of Sizes of Trade and Technical Literature, the F.B.I. Home Publicity Committee, and the I.S.B.A. Exhibition Committee.

Mr. Conlan was born in Dublin in 1892. He joined the B.E.A.M.A. in 1915 as assistant to the then director, Mr. D. N. Dunlop, in his capacity as editor of the *BEAMA Journal,* and returned to the staff after war service in 1918. Some of the numerous B.E.A.M.A. activities in which he played a big part were the electrical section of the Wembley Exhibition in 1924 and the formation of the World Power Conference in the same year; he was also responsible for the many books and other publications produced by the Association, of which the best known are the study of the life and work of Faraday, and the "Catalogue." He was appointed editor of the *Journal* on Mr. Dunlop's death in 1935 and he was secretary of the Publicity Committee from 1945 to 1953, and served as a member of the Committee from that time until his death.

The late Mr. J. J. Conlan

Mr. Conlan was a man of varied intellectual interests ranging from music and literature to the study of economics, sociology and history. He was always helpful in a practical and constructive way.

We extend our sympathy to Mrs. Conlan and family.

Mr. E. E. Hoadley.—The death occurred on 8th July at the age of eighty of Mr. Edward Ernest Hoadley, C.B.E., M.I.E.E., who, before his retirement in 1949, was Maidstone district manager of the South Eastern Electricity Board, and before nationalization was for many years borough electrical engineer of Maidstone. Mr. Hoadley commenced his career in the electricity supply industry with the old Rochester, Chatham & District Electric Lighting Co., which later became the Kent Electric Power Co., and he was subsequently with the Eastbourne, Islington, Barking and Worcester

The late Mr. E. E. Hoadley

undertakings. He left the position of city electrical engineer of Worcester in 1901 to go to Maidstone, where he inaugurated the supply. During his service at Maidstone he made many innovations including the introduction of Ljungstrom turbines and the "Actadis" ripple control system.

His other activities in the supply industry were numerous. For twenty years he served on the Council of the Incorporated Municipal Electrical Association, of which he was secretary for thirteen years. It was during his presidency in 1935 that the National Electrical Convention was held in place of the customary I.M.E.A. Convention.

From 1942 to 1944 Mr. Hoadley was chairman of the British Electrical Development Association and president of the Electrical Industries Benevolent Association. In 1946 he became chairman of the National Consultative Committee of the Central Electricity Board, of which committee he had been a member since 1935. He was appointed liaison officer between the B.E.A.M.A. and the electricity supply industry in 1943 to advise on the manufacturing and marketing of domestic apparatus.

Mr. L. F. Fogarty.—The death occurred on 9th July, at the age of seventy-three, of Mr. Lawrence Francis Fogarty, J.P., M.I.E.E., F.R.S.A., managing director of the Zenith Electric Co., Ltd. Mr. Fogarty was educated at St. Michael's Grammar School, Bayswater, and at the Regent Street and Northampton Polytechnics, and had his training with the Success Manufacturing Co. He had been managing director of the Zenith Electric Co. since its foundation in 1918. He was chairman of the Ruislip-Northwood U.D.C. from 1939 to 1942.

Mr. K. Manheimer, a director and the founder of the Ergon Electrical Manufacturing Co., Ltd., died on 30th June after a long illness.

Lady Gridley.—We extend our sympathy to Lord Gridley, whose wife died on 5th July after a long illness.

Mr. L. Pywell.—The death has occurred suddenly of Mr. Leonard Pywell, London director of Gent & Co., Ltd., Leicester, at the age of fifty-six. Mr. Pywell joined the company at Leicester in 1915 and was in charge of the London office from 1925 until his death. He was appointed London director in January, 1946. He leaves a widow and one son.

The late Mr. L. Pywell

Better Materials Handling

Fisher & Ludlow Conveyor Development Centre

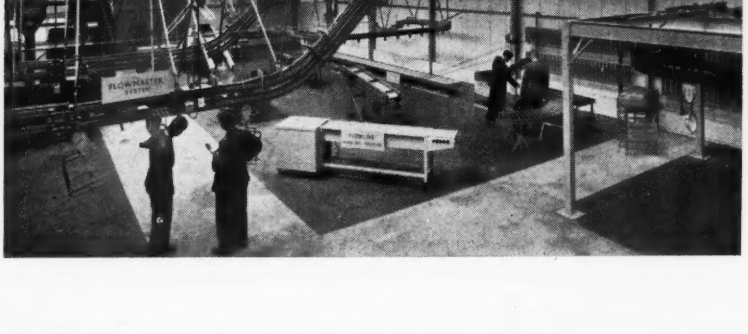
Last week we visited the new conveyor development centre which has been created by Fisher & Ludlow, Ltd., at its Castle Bromwich works in an effort to promote the maximum co-operation between conveyor designer and conveyor user. This centre provides under one roof all the requirements necessary to enable the user and designer to tackle their common problems.

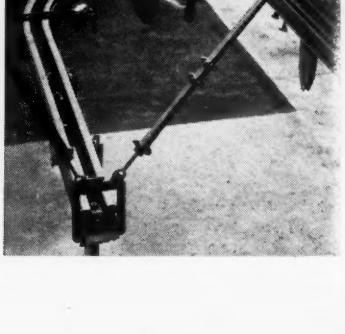
There is a conference room for discussion of problems and also a design office, staffed by engineers with experience in many industries. The centre is also provided with facilities for experimental work and for making prototypes so that the designer can try out his ideas on the spot.

Seventeen different full-size conveyors are installed in the centre for demonstration purposes, all in use. Whichever way a discussion goes it is nearly always possible to examine the actual equipment. In this way a job which appeared to require conveyors might, on closer examination, prove to be one for pallets. Alternatively, a discussion might become too technical for the customer to follow, for instance, when verbal explanations of what the "Flowmaster" system will do become too involved the actual installation is there to be put through its paces and to demonstrate that it is as useful as it is claimed to be. One demonstration is usually enough to fix firmly in the mind the principles on which it operates.

As a background to the centre there is the company's manufacturing plant, one of the largest of its kind in Europe, where a wide range of mechanical handling equipment can be seen under production conditions.

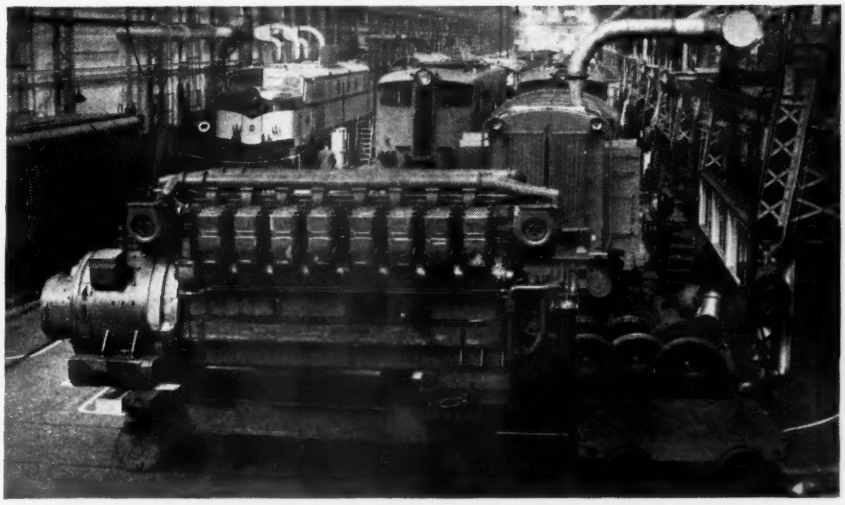
Left: Some of the 17 conveyor systems in the demonstration area with the "Flowmaster" system in the foreground. Right: A junction on the "Flowmaster" conveyor, which permits trolleys to switch from live lines to dead tracks and, equally well, feed trolleys from dead tracks back on to a live conveyor line





Traction Locomotives

VISIT TO PRESTON WORKS OF THE ENGLISH ELECTRIC CO.



The traction shop at the company's Preston works

LAST Friday a number of representatives of the daily and technical Press visited the Preston works of the English Electric Co., Ltd., where they were shown some of the manufacturing facilities, methods and products of the company in the spheres of both diesel-electric and electric traction.

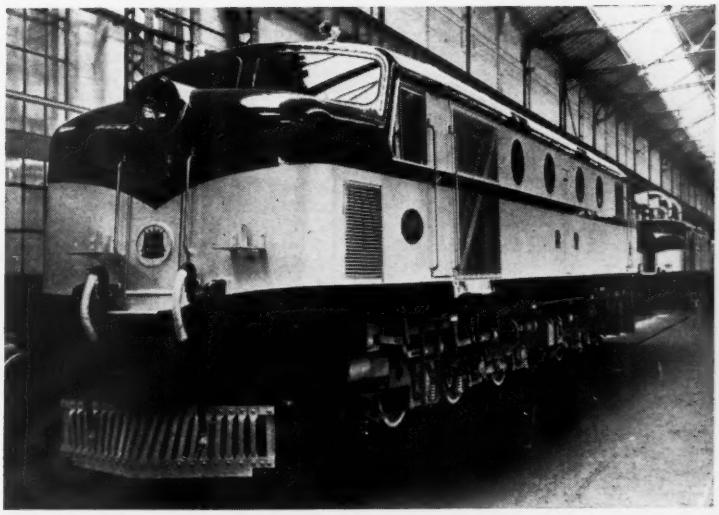
In a paper to the British Electrical Power Convention last year Sir George Nelson, chairman and managing director of the company, stated that although Britain produced the first steam locomotive over a century ago, out of some 19,000 locomotives running in the United Kingdom to-day we had only 81 electric and six main-line diesel-electric locomotives in service. As electrification and "dieselization" would increase efficiency on the railways by savings in working expenses, and would provide the public with better rail services, these forms of traction should be adopted as soon as possible, both for their own sake and to ease traffic on our roads. By so doing a "base load" would be provided for overseas trading in electric and diesel-electric locomotives.

The English Electric Co. is one of the leading manufacturers of these locomotives in this country and claims to be the only company making them completely under one roof. Over the last half-century traction equipment has been supplied to seventy-six systems in twenty-nine countries in powers ranging from 350 to 3,600 h.p. Since the end of the war the company has received orders aggregating more than 1,000,000 h.p. for home and overseas use. Diesel engines for use in locomotives are made in the same works, being of the in-line or VEE type, many exhaust turbo-charged.

Among the completed diesel-electric units seen at Preston was one of an order of 23 for the Rhodesian Railways. These are 1 Co Co 1 type, of 2,000 h.p., intended for a maximum speed of 60 m.p.h., and costing about £60,000. They are attractive in appearance and well equipped. As yet none of this type have appeared on our own railway system.

Also seen in the Preston works were a number of mobile power plants ordered by the London County Council, the Metropolitan Water Board and the Ministry of Supply for use in defence emergencies. Some of these were mounted on 32-wheel trailers complete with engine, generator and controls on the one chassis and producing about 400 kW. Other mobile power plants being manufactured were on skids.

2,000 h.p. diesel-electric locomotives for Rhodesia



Electrical Equipment in s.s. "Ivernia"

Electrical generating machinery consisting of four generators, each of 750 kW 225 V d.c., driven by steam turbines, is installed in the new 22,000 tons Cunard liner *Ivernia*, now on her maiden voyage in the company's Canadian service. The turbo-generators were designed and constructed by the British Thomson-Houston Co., Ltd., and in accordance with latest power station practice each turbine is provided with a separate condenser incorporated in the design of the set. The main switchboard is housed on an athwartship platform at the aft end of the main engine room. The cables are connected to 17 auxiliary switchboards and are so connected as to form several ring mains, enabling the port and starboard boards to be fed from the port or starboard side of the main switchboard. There are about 430 electric motors, ranging from ⅛ h.p. to 470 h.p., all the deck machinery such as steering gear, windlass, capstans, cargo, baggage and boat winches, etc., is electrically operated, and auxiliary machinery in the engine room and boiler room is, in the main, electric.

Lighting makes a big demand, there being more than 10,000 lamps throughout the ship. Indirect lighting has been adopted in all public rooms and employs 3,500 lamps. Fluorescent lighting has been used in the shops, galley and for the engine room control platform, main switchboard platform and in the boiler room. Power plant for this purpose and other services, situated on the main switchboard platform, consists of two 25 kVA 3-phase 220 V motor alternators. In the kitchens all cooking ranges, hot presses, ovens, etc., are electrically heated and in addition there are electric fryers, salamanders, mixing machines, coffee grinders, ice shaving machine, burnishing machine for ranges and silver, toasters, waffle irons, griddle plates, dish washing machines, cutting machines, orange juice extractors, dough mixing machines, dough dividing and roll making machines, ice cream and ice breaking machines, knife cleaning machines, etc.

An emergency electrical supply can be obtained from two 75 kW diesel-driven generators, a nickel-iron battery capable of supplying the emergency circuits for half an hour also being installed. For communications inside the ship a "Strowger" automatic telephone system has been installed by Communication Systems, Ltd. The exchange has an ultimate capacity of 100 lines and is equipped initially for 60 lines.

Increased Coal Prices

As from Monday next the National Coal Board is increasing the present inland prices of coal by 18 per cent, or an average of 11s 5d a ton. The yield will be £53 million in 1955 and £118 million in a full year.

The increases for house coals will range from 7s 11d to 19s 1d a ton according to quality. For the main industrial groups the average increases are stated to be as follows:—Gas works, 12s 5d; power stations, 9s 3d; railways, 12s 5d; N.C.B. coking plants, 12s; other coking plants, 11s 8d; iron and steel, 11s 6d.

When these price increases have taken effect the Coal Board proposes to examine, in consultation with organized consumers, the relationship between the prices of the various classes of coal, but without departing from the general principle that prices will continue to be based primarily on coal quality, nor with the object of increasing the Board's revenue.

In a memorandum protesting against the increases, the Association of British Chambers of Commerce expressed grave concern at the probable consequences, saying that such a significant rise in the cost of living would almost inevitably be followed by a fresh wave of demands for higher salaries and wages. It suggested that the wages in the coal-mining industry should in future be strictly related to output; that there should be an impartial investigation into the potentialities of the programme of capital development and reconstruction; and that part of the planned capital expenditure might be employed to encourage the use of oil in industry and to accelerate atomic energy research and development.

The Federation of British Industries and the National Union of Manufacturers drew attention to the serious effect the increases would have on manufacturing costs and thus on export trade.

Sir Leslie Hollinghurst, chairman of the National Industrial Fuel Efficiency Service, said that at first sight the increase in industry's fuel bill might seem a serious threat to our power to compete in the export markets of the world, but N.I.F.E.S. had found that there were few works in general industry where fuel consumption could not be reduced by 15 to 20 per cent. In order to help industry, N.I.F.E.S. was increasing its engineering staff and was now ready to accept additional work in every area of the country. Between now and September firms should enrol their firemen at the nearest technical college for boiler operators' certificate courses. If it was impracticable to send the operators to the technical college, N.I.F.E.S. was prepared to bring the training to the operators.

Storage Heaters

In our note under the above heading relating to new additions to the range of storage heaters manufactured by Thermodare (Great Britain), 79-80, Petty France, London, S.W.1, the price of the standard 1½ kW model was given as £12. This should have been £12 10s.

NUCLEAR POWER EXHIBITION

On Friday last an exhibition arranged by the Central Electricity Authority was opened at Charing Cross (Embankment) Underground Station to inform the general public about electricity from nuclear energy. This exhibit, which was shown at the recent Power Convention at Brighton, will remain on view until Tuesday, 26th July. With the aid of models and diagrams the exhibition shows in a remarkably clear manner the process of nuclear fission and how it is used in the generation of electricity.

The Central Electricity Authority's power station construction programme provides for 10·5 million kW of new generating plant to be commissioned by 1960. It will all be coal fired. In addition, construction of twelve nuclear power stations in the next ten years is planned at a cost of about £300 million.

By 1965 the total generating capacity installed in C.E.A. power stations will be about 35-40 million kW. The ratio of nuclear reactor to fuel-fired plant will be about 6 to 7·5 per cent. Looking ahead another ten years to 1975, total generating capacity will have risen to between 55 and 65 million kW, of which some 10-15 million kW will be contributed by nuclear power stations.

PRICES OF MATERIALS

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £163 0s 0d
COPPER, H.C. Electro	ton £340 10s 0d
Fire Refined 99·70%	ton £339 0s 0d
Fire Refined 99·50%	ton £338 0s 0d
COPPER Tubes ..	lb 3s 3½d
Sheet	ton £409 5s 0d
H.C. wire and strip ..	ton £384 5s 0d
LEAD, English ..	ton £104 5s 0d
Foreign	ton £103 0s 0d
MERCURY	flask £108 0s 0d
TIN, block (English) ..	ton £729 5s 0d
ZINC, G.O.B. Foreign	ton £92 10s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 7½d
Sheet	ton £325 15s 0d
Wire	lb 3s 2½d
PHOSPHOR BRONZE Wire	lb 4s 9½d
PLATINUM	oz £29 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 37½d—38d

VIEWS on the NEWS

By REFLECTOR

A PROJECT of long-term significance is referred to in the latest report of the Fuel Research Board, which points out that the day is far distant when a chemical formula can be written down for coal. Some change sets in when its carbon content reaches 90 per cent or so—a "rank" to which coal tends to aspire but which it requires millions of years in the earth to reach. Professor D. M. Newitt at Imperial College, London, is investigating the possibility of quick maturing by exposing coal to very high pressures at moderate temperatures. The effect if successful should, I take it, materially add to our resources of smokeless fuel and perhaps increase the availability of coals having the characteristics most in demand.

* * *

Electric irons are, I suppose, the longest-lived of all electrical appliances. Anyhow I have had many examples of ancient irons brought to my notice in recent years. Nevertheless half a century of use may be a record and so I refer to a tailor's iron which has been employed at the Inns of Court Mission Institute, Drury Lane, London, for the billiard tables there since 1905. Even then the iron was not new. Recently, for the first time, it needed repair and finally went back to the makers—the G.E.C.—who found it listed in an 1898 catalogue. It has an element embedded in enamel which is still in working order; the trouble was a faulty contact. The iron has now been put into the company's museum and replaced by a new one.

* * *

If the cobbler's children are the worst shod, it is too frequently the case that the electrical man's home is the worst equipped electrically. There were reminders of this at the "Electrical Forum" held during the Brighton Power Convention when one member of the panel (Mr. A. M. F. Palmer) suggested that electrical people who cooked by gas should be "drummed out" of the industry. While I would not like to see a public scandal created in this way I would certainly support measures for the compulsory intensive electrical education of the delinquents. The *Electrical Review* has done its best for long years to show how desirable it is for electrical people to take their own medicine. As far back as 1932 Mr. R. D. Reynolds (now with E.D.A.) contributed an article showing how detrimental to development was the indifferent attitude of electrical men in private life. He, too, advocated intensive education, though not compulsory.

* * *

Should nationalist sentiment or plain economics govern the supply of electricity? Where the two are in consonance the question is easily decided as, maybe, it has been in Scotland. The position in Wales is not so clear. At a recent meeting in Cardiff members of the Herbert Committee heard the views of Welshmen upon the subject of future electricity supply in Wales. Mr. H. V. Barter, director of the Industrial Association of Wales and Monmouthshire, was satisfied with the present arrangement. He feared that if North Wales were cut off from Merseyside and served by an all-Welsh board the price of electricity would go up. On the other side Professor H. Lewis, for the Council of Wales, said that the unification of electricity supply in Wales would speed up rural electrification and "make a community of interests between the rural area of Anglesey and the industrial regions of Glamorgan."

* * *

Most of my frequent fish stories have been records of happenings adverse to the fish and complaints by anglers. It is pleasant to learn of happier circumstances. The *Evening Standard* says:—

> "Since a new power station started to discharge warm water into Carmarthen Bay on the Welsh coast, shoals of bass, pollack and flatfish have arrived, and anglers are reeling in record catches."

The *Standard* goes on to say that since this influx started the South Wales Sea Fisheries Committee is welcoming the proposal of the C.E.A. to erect another station at Aberthaw, near Barry. This change of attitude should be of great encouragement to the Authority. All it needs now is for planning authorities to press for new power stations to improve the architectural aspects of their areas.

* * *

An American control device which switches a standard lamp on and off merely by touching any part of the metal base is described in the *Manchester Evening News*. It can be used in place of the ordinary mechanical switch and, says the newspaper, "costs only about £1 15s more than a conventional switch." I rather like that "only."

* * *

A recent issue of the *Electrical Review* contained details of the power stations of the United Kingdom. Fifty years ago (14th July, 1905) the journal published a similar sort of supplement in which particulars were given of the 382 electricity supply works then in operation. The capacity of these ranged from 13 kW (Treeton Parish Council) to 22,000 kW (City of London Electric Light Co.). The latter station had plenty of spare capacity for the maximum recorded load was only 15,000 kW. In fact most of the works had fairly good margins. Generally the plant was steam-engine operated but a number of stations had Parsons turbines; there were fifteen Parsons sets at Newcastle-on-Tyne. The average price received per kWh sold varied between 1·25d (Prescot—B. I. & H. Cables, Ltd.) and 6·2d (Oswestry). The list of engineers and managers contained a number of well-known names, including S. L. Pearce (Manchester), R. P. Sloan (Newcastle), J. H. Clothier (St. Annes-on-Sea), S. E. Fedden (Sheffield), J. F. C. Snell (Sunderland), C. P. Sparks (County of London), J. S. Highfield (Metropolitan E.S. Co.) and A. B. W. Kennedy (Westminster).

Fifty Years of Electric Traction

THIS summer marks the 50th anniversary of the electrification of London Transport's District Line. Originally opened for traffic, with steam trains, in October, 1868, the District Railway found itself faced with serious competition when, in 1900, the electric service of the Central London Railway (the "Twopenny Tube") provided a quicker, more comfortable and cleaner route across London. Moreover, the advent of the electric tram and the mechanically-propelled bus at much the same time underlined the urgent need to modernize the District Railway if it were to continue to pay its way.

An experimental electric service was begun in May, 1900, between Earls Court and High Street, Kensington, but custom soon declined and the service was withdrawn in November. In the following year, however, a decision was taken to electrify the entire railway. This was a matter which vitally concerned the Metropolitan Railway, since the latter's trains on the Inner Circle service ran over District metals and a controversy arose over the method of electrification. The Metropolitan Railway favoured a high-voltage 3-phase system with overhead conductor wires, while the District company preferred a low-voltage a.c. system with conductor rails. A Board of Trade tribunal gave judgment in favour of the latter and June, 1903, saw an electrified line installed between Ealing and South Harrow, with a four-rail system of the type which has now become standard on London's Underground Railways, i.e., with the positive rail to one side of the track and the negative rail in the centre. This was followed two years later, in June, 1905, by the opening of South Acton station and the provision of an electric service between there and Hounslow. Electrification of the remaining sections quickly followed and on 5th November all remaining steam trains were withdrawn.

To supply the required power the Lots Road, Chelsea, generating station—at the time one of the largest in the country—was erected. Electrification brought a new lease of life to the "District." The 3¼ minute average service interval for steam trains on the Mansion House/South Kensington section was cut to 2½ minutes in 1907 and to 90 seconds in 1928. To-day the District Line has the distinction of having the busiest section of all London Transport tracks in the peak periods.

Top: Steam locomotive No. 33 built in 1881 and 3-coach train

Bottom: Latest type of District Line rolling stock—an unpainted 8-car train of aluminium-alloy construction, introduced in 1953

Electrical Engineering Summer School

WE have received from the Regent Street Polytechnic, London, a copy of the programme of a summer school which is to be held by the Electrical Engineering Department from Monday, 12th September, to Friday, 16th September, this year. The school will include lectures on insulating materials and their use as follows:—

Monday, 12th September—"Recent Developments in Dielectric Materials," by Mr. R. F. Archer, B.Sc., Metropolitan-Vickers Electrical Co., Ltd.; "Permittivity, Dielectric Loss, Absorption and Conductivity," by Mr. C. G. Garton, M.I.E.E., F.Inst.P., Electrical Research Association; "Dielectric Breakdown; General Principles," by Mr. J. H. Mason, B.Sc., A.Inst.P., A.M.I.E.E., Electrical Research Association.

Tuesday, 13th September—"Dielectric Breakdown; Recent Advances in Testing," by Mr. P. R. Howard, B.Sc.(Eng.), A.M.I.E.E., National Physical Laboratory; "Insulation Testing (with particular reference to non-destructive testing)," by Mr. G. Mole, Ph.D., F.Inst.P., Electrical Research Association; "Insulation of Outdoor Equipment," by Mr. J. S. Cliff, M.I.E.E., General Electric Co., Ltd.

Wednesday, 14th September—"Insulation Co-ordination," by Mr. D. F. Oakeshott, B.Sc., A.M.I.E.E., Central Electricity Authority; "Dielectrics in Cables," by Mr. B. Salvage, Ph.D., B.Sc.(Eng.), A.M.I.E.E., W. T. Henley's Telegraph Works Co., Ltd.

Thursday, 15th September—"Dielectrics in Capacitors," by Mr. H. F. Church, B.Sc., Electrical Research Association; "Temperature Classification and Thermal Endurance," by Mr. A. Collins, B.Sc., M.I.E.E., Micanite & Insulators, Ltd.

Friday, 16th September—"The Insulation of Power Transformers," by Mr. A. C. Franklin, M.I.E.E., Johnson & Phillips, Ltd.; "The Insulation of Electrical Machines," by Mr. E. Jones, B.Sc.(Eng.), M.I.E.E., A.M.I.Mech.E., English Electric Co., Ltd.

Each lecture will be of approximately one hour's duration and discussion periods will be arranged. Laboratory demonstrations and visits to laboratories and works in the London area will be included in the course. The fee for the whole course (inclusive of lunches and refreshments) will be £5 5s. Enrolment forms, synopses of the lectures and further information may be obtained on application to the Head of the Electrical Engineering Department.

Anglo-French Television Link

THE B.B.C. has been informed by the Post Office that the first section of the permanent vision link between London and the Continent, ordered last January, will be completed in September. This section consists of a two-way coaxial cable circuit between London and St. Margaret's Bay. The next section, which will be a two-way radio link across the English Channel, has also been ordered but is not due for completion until 1958.

Meanwhile, in order that Britain can participate in a series of international television programme exchanges planned for the coming autumn, the coaxial cables will be temporarily extended from St. Margaret's Bay to Swingate, near Dover, where the B.B.C. and Radiodiffusion-Télévision Française will provide and operate a temporary two-way radio link across the Channel between Swingate and Cassel in Northern France.

Printing Machinery

Tenth International Exhibition at Olympia

THE tenth International Printing Machinery and Allied Trades Exhibition began at Olympia on 5th July and closes to-morrow. Since the first was held in 1904 the exhibitions have been growing steadily in size, scope and importance until this year an impressive display completely fills the halls and galleries of Olympia. Altogether there are about 338 exhibitors, 40 of whom are from overseas.

The printing industry has always been well to the fore in its adoption of speed regulating and speed synchronizing electrical devices for its machines and many of the exhibits are driven by variable speed a.c. motors or by other conventional means. Electronic systems for the control and automatic adjustment of many operations are now becoming more numerous and one application arousing considerable interest is that of electronic engraving to produce blocks for printing. By this means plates for printing can be produced in 7 or 8 minutes. Several firms show equipment of this nature.

Photo-Electric Scanning

In the Clichograph exhibited by Dr.-Ing. Rudolf Hell, of Kiel, Germany, the original picture is photo-electrically scanned by a process corresponding to that employed in picture telegraphy so as to produce a photo-electric current. This current is amplified and used for the control of an engraving tool. A screen frequency superimposed upon the control current causes the tool to engrave dot by dot a halftone printing plate, the so-called "Clichogram," in which the sizes of the screen elements correspond to the brightness values of corresponding parts of the original picture. At present this process is not completely satisfactory for very fine screens but development work is under way.

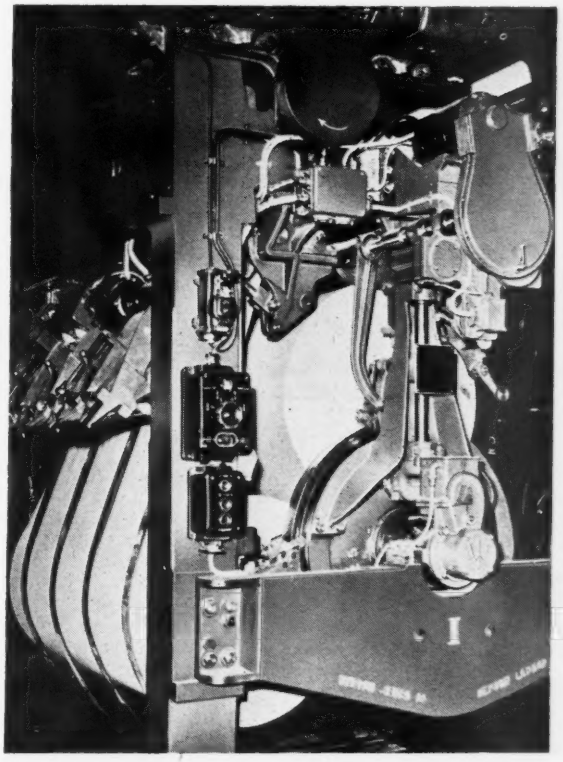
J. F. Crosfield, Ltd., and Aga Standard, Ltd., have somewhat similar devices. The former is also demonstrating its "Idotron," a photo-electric ink density monitor for uniform colour reproduction. With the orthodox method for maintaining consistency of thickness or density of an ink film deposited on a web in rotary colour printing, the printer has—apart from using static instruments—to rely on his skill and experience to obtain uniform colour quality throughout a run. This system uses a photo-electric scanning head built of light alloy and mounted on a bar close to the web after the last printing cylinder. This views sequentially the colour test marks printed in each colour in a margin of the web and emits amplified signals to a distant control cubicle which has four meters, one for each of the colours in use. Once the system has been set up and the required colour values established in proofing, the appropriate meter for each colour is set to a central zero position and any subsequent deviation from these values which may occur during the run is clearly indicated on the meter panel. A change of as little as 1 per cent from a given standard value gives the printer ample warning of any developing change in the consistency of the ink film.

One stand shows a system of radio tele-typesetting in which a message is typed on to tape, including symbols to indicate the size of type; this is fed into a radio transmitter and the message is received (in the case of the exhibition only of course) several yards away. Here it is turned back into tape which goes into a typesetting machine and is set automatically.

One of the largest machines in the exhibition is a section of a multi-colour newspaper press by R. Hoe & Crabtree, Ltd. This incorporates radical developments which eliminate the human factor wherever possible. Reels of newsprint are automatically changed, the register is automatically controlled, ink feed is automatic, etc. Electrical control operates most of the automatic features.

Witton-James, Ltd., show their "Autopaster" which is designed to incorporate the latest method of changing over to a new reel of newsprint on a rotary printing press without slowing the press. An electronic system using thyratrons to control d.c. motors matches the peripheral speed of the new reel with the linear speed of the paper leaving the old reel, preparatory to the operation of splicing the reels and severing the remaining portion of the old one. A development of this, jointly with Beaverbrook Newspapers, Ltd., the "Roboreel" device, makes the process of changing reels completely automatic and enables it to be initiated at a predetermined stub diameter of the expiring reel.

Witton-James "Autopaster" with electronic control for speed matching when changing reels



World Power Conference

AT the recent annual general meeting of the British National Committee of the World Power Conference Sir John Hacking was re-elected vice-chairman and Mr. F. G. Brewer (secretary, Gas Council) was re-elected hon. treasurer. It was decided to extend invitations to the National Industrial Fuel Efficiency Service and to the Institution of Heating and Ventilating Engineers to appoint representatives to serve on the committee. These invitations have been accepted, and Dr. W. A. Macfarlane, the chief executive, now represents the N.I.F.E.S., while Mr. Walter Harding represents the Institution of Heating and Ventilating Engineers. Sir Walter Drummond, until recently deputy chairman of the National Coal Board, was elected an individual member of the committee. The Executive Committee, British National Committee, W.P.C., has extended an invitation to the United Kingdom Atomic Energy Authority to appoint a representative to serve on the committee, subject to formal ratification at the 1956 annual general meeting. The Authority has accepted this invitation and has appointed Mr. C. E. Iliffe to serve as its representative.

A meeting of the International Executive Council, W.P.C., was held in Paris on 2nd and 3rd June last. Sir Vincent de Ferranti, M.C., who is also chairman of the British National Committee, presided as chairman of the International Executive Council. The other representatives of the British National Committee were Sir John Hacking and Dr. A. Parker, C.B.E., respectively vice-chairman and hon. secretary of the Committee. There was the largest attendance at any Council meeting since the meeting held in London in 1950 at the time of the fourth World Power Conference. Twenty-eight member-countries were represented by forty-five delegates.

The time-table for the fifth World Power Conference was discussed, as was the draft technical programme of the Sectional Meeting to be held in Yugoslavia in June, 1957. The acceptance of the invitation of the Canadian National Committee, now supported by the Canadian Government, for a Sectional Meeting in Canada in 1958 was reaffirmed. This Sectional Meeting will take place in Montreal in September, 1958. Next will come a Sectional Meeting in Switzerland in 1960. The invitation of the Australian National Committee for the sixth World Power Conference to be held in Australia in 1962, or alternatively for a Sectional Meeting to be held there, was discussed. With notable enthusiasm and unanimity, it was decided to hold the sixth World Power Conference in Australia in 1962.

Mexico and the Saar were admitted as members of the World Power Conference, and it appears likely that, after the completion of formalities, Venezuela will be admitted in the near future. Recognition was accorded to a committee of the World Power Conference set up in Trinidad and Tobago, British West Indies. There are now forty-six member-countries.

The fifth World Power Conference is to take place in Vienna from 16th to 23rd June, 1956, the technical sessions being from 18th to 23rd June. On 25th June post-Conference tours will take place lasting for six to ten days. The British National Committee has arranged for the preparation of 26 papers, including those listed below.

PAPERS FOR PRESENTATION AT 1956 CONFERENCE

"Energy Resources of the United Kingdom and Trends in their Utilization," by the Chief Scientist's Division, Ministry of Fuel and Power.

"Oil as a Factor in Future Energy Supplies," by O. F. Thompson, O.B.E., F.Inst.Pet., manager, Trade Relations Department, Shell Petroleum Co., Ltd.

"International Power Statistics," by G. H. Daniel, D.Phil., B.Sc., chief statistician, Ministry of Fuel and Power.

"Experiences in Pulverizing Coal," by R. L. Brown, M.A., F.Inst.F., F.Inst.P., director of Research Laboratory, British Coal Utilization Research Association, and T. F. Hurley, O.B.E., B.Sc., A.M.I.C.E., F.Inst.F., chief research engineer, Fuel Research Station, Department of Scientific and Industrial Research.

"Recent Developments in British Power Station Design," by F. H. S. Brown, B.Sc., M.I.E.E., M.I.Mech.E., and D. Clark, B.Sc.(Eng.), A.C.G.I., A.M.I.E.E., Chief Engineer's Department, Central Electricity Authority.

"The Work of the Boiler Availability Committee since the Fuel Economy Conference of the World Power Conference held at The Hague in 1947," by H. E. Crossley, Ph.D., M.Sc., B.Sc.Tech., F.Inst.F., A.R.I.C., scientific adviser, Generation Operation Branch, Chief Engineer's Department, Central Electricity Authority.

"Recent British Progress in the Design of Steam Turbines for Large Outputs," by P. D. Morris, M.I.Mech.E., manager, Steam Turbine Engineering Department, British Thomson-Houston Co., Ltd.

"Recent Research in Great Britain on Fuel Cells," by J. S. Forrest, M.A., D.Sc., M.I.E.E., F.Inst.P., director of laboratories, Central Electricity Authority, and F. T. Bacon, M.A., A.M.I.Mech.E., Department of Chemical Engineering, University of Cambridge.

"A Critical Survey of the Development of the Heat Pump in Great Britain," by Miss M. V. Griffith, B.Sc., F.Inst.P., head of the Heating Section, Electrical Research Association, and John A. Sumner, M.I.E.E., M.I.Mech.E., F.I.I.A.

"Some British Developments in Large Plant for Hydro-Electric Power Generation," by M. Braikevitch, A.C.G.I., D.I.C., chief hydraulic engineer, English Electric Co., Ltd.

"The Economics and Practical Application of Pumped Storage," by T. Lawrie, C.B.E., F.R.S.E., M.A., M.I.E.E., M.I.Mech.E., general manager, North of Scotland Hydro-Electric Board, T. G. N. Haldane, M.A.(Cantab.), M.I.C.E., M.I.E.E., Fel.A.I.E.E., partner in Merz & McLellan, and R. W. Mountain, B.Sc.(Eng.), M.I.C.E., M.I.E.E., partner in Kennedy & Donkin.

"The Methods of Using and Processing Nuclear Fuels in a Nuclear Power Programme, including a Study of Recycling Procedures," by J. V. Dunworth, C.B.E., M.A., Ph.D., F.Inst.F., head of the Reactor Physics Division, Atomic Energy Research Establishment, United Kingdom Atomic Energy Authority.

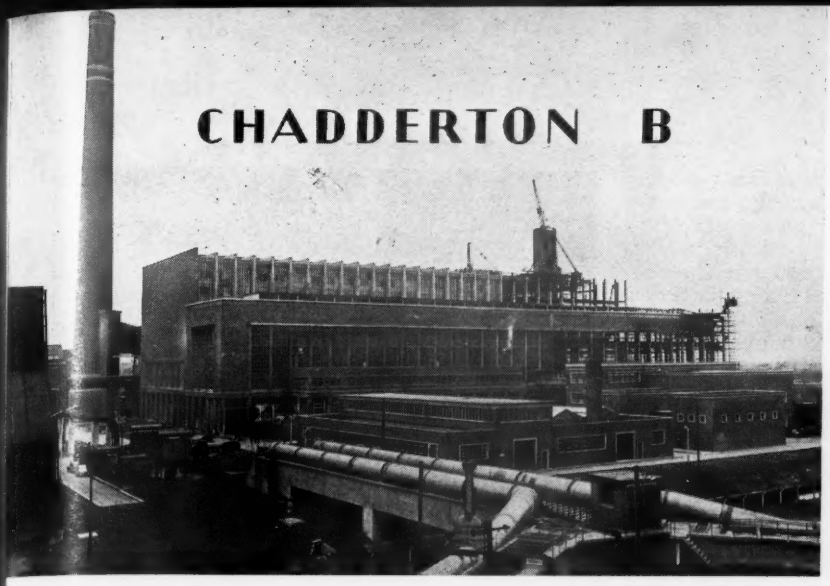
"The Technical Problems of Designing and Operating Reactors for Producing Electrical Power and the Problems of Making them Economic," by H. H. Gott, M.A., A.M.I.Mech.E., Atomic Energy Industrial Group.

"Nuclear Generation and the Future Power System in Great Britain," by J. C. Duckworth, B.A., P. J. Squire, B.Sc., A.M.I.E.E., and V. G. Newman, B.Sc.(Eng.), A.M.I.C.E., A.M.I.Mech.E., Chief Engineer's Department, Central Electricity Authority.

"Air Pollution and Waste Gases from the Preparation and Utilization of Fuels," by A. Parker, C.B.E., D.Sc., M.I.Chem.E., F.R.I.C., M.Inst.Gas E., F.Inst.F., director of fuel research, Department of Scientific and Industrial Research.

"The Disposal of Waste Waters and Gases in a Nuclear Power Programme," by D. R. R. Fair, O.B.E., B.Sc., A.Inst.P., A.K.C., A. S. McLean, M.B., Ch.B., D.I.H., and H. J. Dunster, A.R.C.S., B.Sc., United Kingdom Atomic Energy Authority.

CHADDERTON B



Official Opening Last Week

LAST Friday Councillor F. Kenyon, J.P., chairman of the North Western Electricity Consultative Council, officially declared open the Chadderton " B " power station which will have an ultimate installed capacity of 240 MW. Originally the Oldham area in which the new station is situated was served by the Slacks Valley power station (now known as Chadderton " A ") put into service in 1929. This contains at present three 12·5 MW sets which are still in constant use throughout the winter and occasionally if required in the summer.

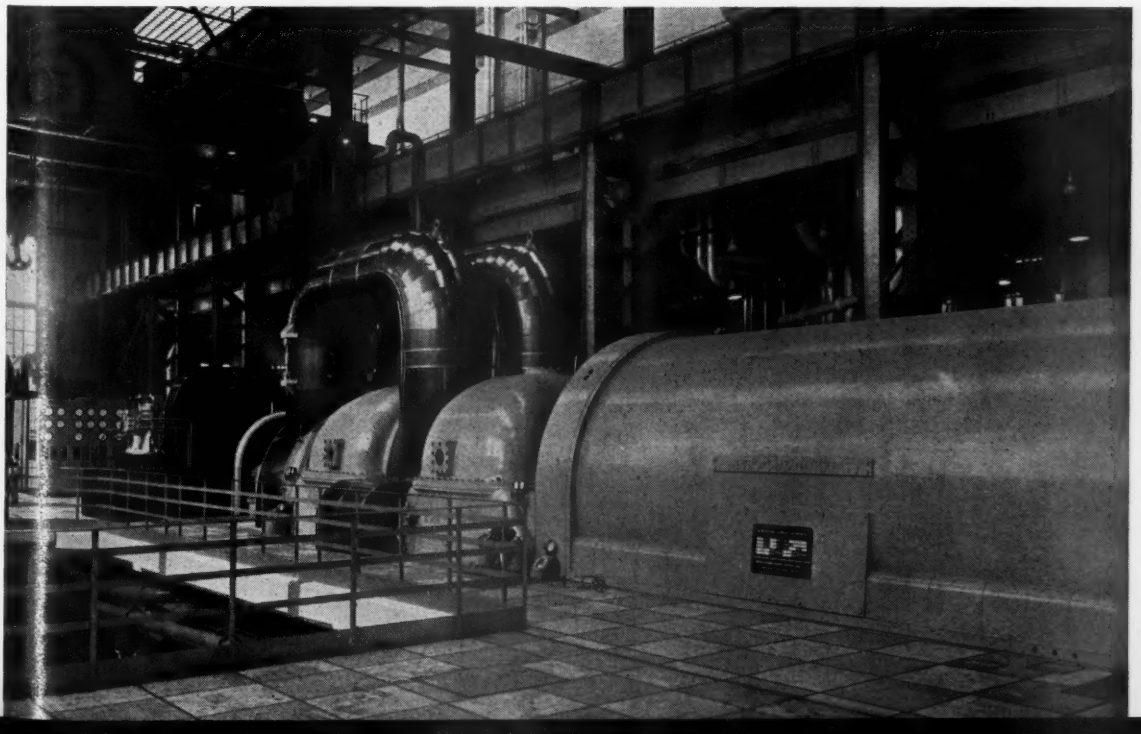
Investigations were started in 1943 by Oldham Corporation into the most suitable site for a new generating plant and it was decided that the area of land adjacent to the existing installation was the most suitable from many points of view. It was one of the few open sites in a heavily built-up load area, and it had an adequate source of cooling water available, comparatively rare in this area, and good railway access. After discussion with the former Central Electricity Board it was planned to install four 50 MW sets but later standardization led to the adoption of 60 MW units. Consent for the first section was granted to the new Central Authority in January, 1950, and for the second section, in September of the same year. The first set was commissioned in December, 1953, and the second in September, 1954.

The ground consisted of several feet of sandy clay with patches of running sand followed by soft clay at depths varying from 6 to 10ft. Altogether about 7,000 *in situ* piles have been driven averaging 40ft in length and of 18in diameter. The foundation rafts in the main buildings are of beam and slab construction spanning the pile caps. The building itself is about 515ft long and 320ft wide, faced externally with light-coloured sand-faced rustic bricks with pre-cast concrete framed windows in the main elevations. There is a separate administration block housing also the control room and connected to the turbine house by a pre-stressed concrete bridge of 112ft span. There will be two chimneys each serving one half of the station. At present only one of these is completed, the other being about half built.

Coal Supply

Coal, of which up to 9,000 tons a week is required at present and as much as 15,000 tons will be needed on

Inside the turbine hall; showing Metropolitan-Vickers 60 MW hydrogen-cooled turbo-alternator



completion, is obtained from two sources, firstly rail-borne from the East Midlands area and, secondly, road-borne from Yorkshire open-cast mines. At present more than half of the coal supply is brought in by road, an unusual arrangement but one which has been found to be cheaper: the station was most favourably placed during the recent railway strike. Lorries discharge on to a road grating if their load is of reasonably fine material but unfortunately much of the open-cast coal consists of large lumps of a size rarely met with at power stations. This is normally off-loaded on to a much coarser grating into which coal is reclaimed from the stock pile, but even here there are difficulties as is evidenced by our photograph which was taken shortly after a lorry had discharged. Pieces like this have to be broken up with a sledge hammer. After passing through this coarse grating or the finer grating in the roadway, the coal goes into a collecting hopper in the crusher house from which it may feed on to the main conveyor either directly or via a crusher.

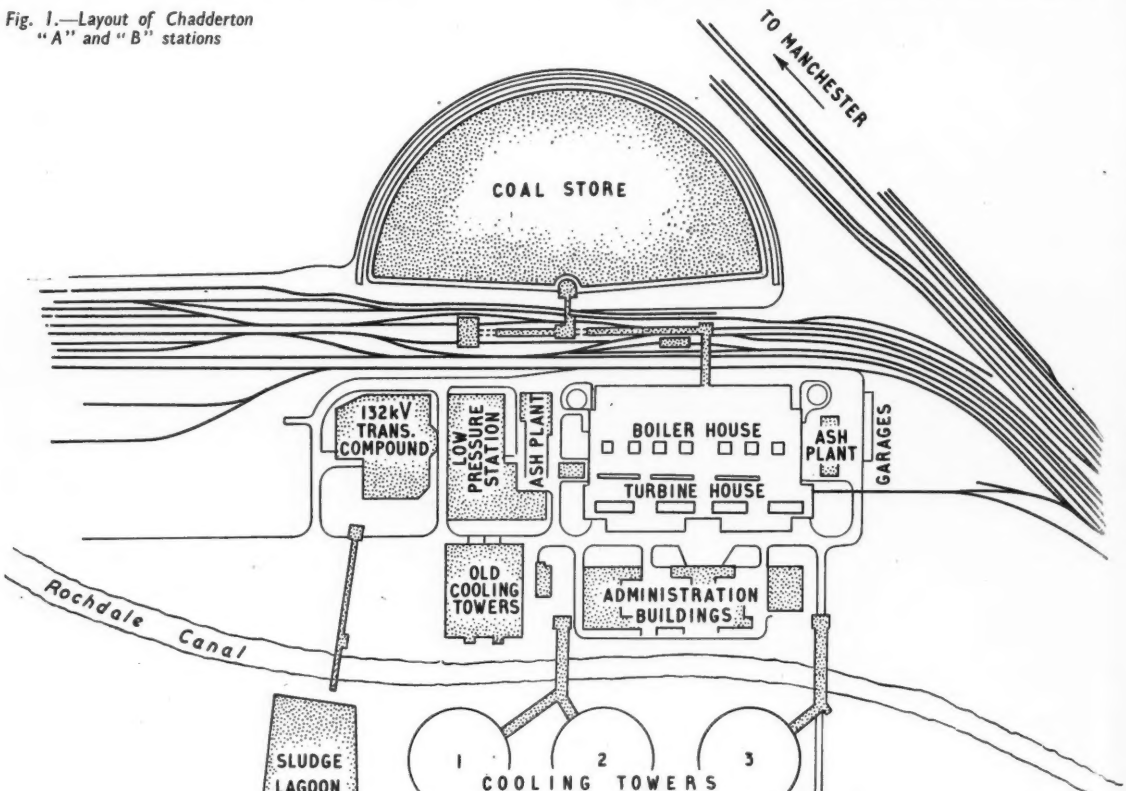
Rail-borne coal is off-loaded on to rotary wagon tipplers capable of dealing with 20 wagons an hour each and incorporating Avery totalizers. Coal from this point feeds by conveyor to the crusher house where it may be fed direct or via the crusher on to the main conveyor to the bunkers or it may be led on a short conveyor capable of radial movement into the stock piling area. Distribution over the stock area, which has a total capacity of about 80,000 tons, is by a drag scraper with a 160 cu ft capacity bucket holding about 71 cwt. Altogether the railway sidings of the station can accommodate 500 wagons. The conveyor tippler and scraper system associated with the coal handling plant has about 620 h.p. of motors.

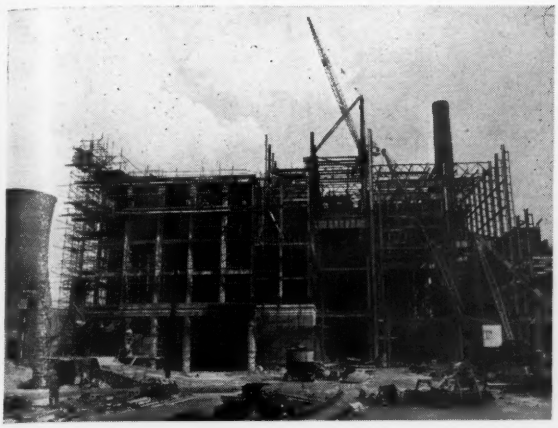
As make-up for the cooling water Chadderton "B" uses

The screen of the coal reclamation hopper. Massive coal of this nature comes from opencast workings

sewage effluent from the nearby Oldham Corporation Sewage Works. From the filter beds the effluent is led through two rotary screen filters and pumped to the power station by four Mather & Platt 50 h.p. induction motor driven pumps. If demanded additional supplies of effluent from further filter beds can be released into the pond outside the pump house by a float control. From the pump house twin 10in pipe lines, well lagged against frost, run to the cooling towers. This water tends to have a fairly high acidity and is dosed daily with soda ash: if the present two sets are running on full load the quantity of this required may be as much as $\frac{3}{4}$ ton per day.

Fig. 1.—Layout of Chadderton "A" and "B" stations





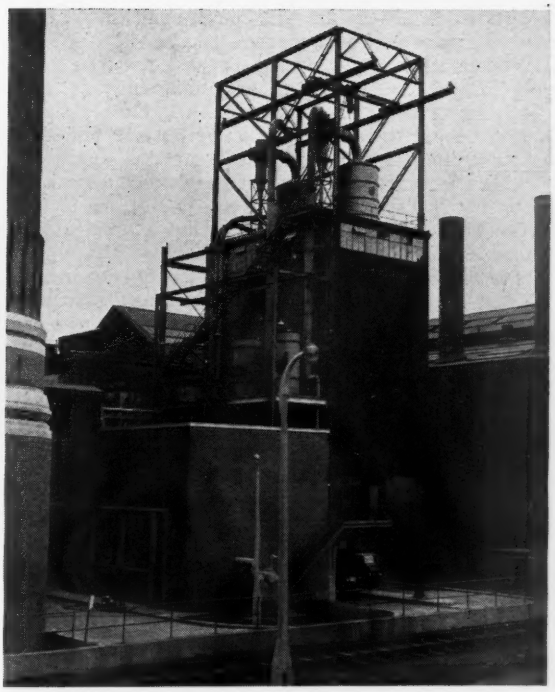
State of construction on second half of station. No. 5 boiler is well advanced

At present there are two cooling towers each capable of dealing with 3,500,000 gal/hr through a range of 12 deg F and a third tower is at present under construction. Each tower is 310ft high and has base and rim diameters of 210 and 137ft. From the cooling towers reinforced concrete circulating water ducts connect to the turbine house. The ducts are in pairs each 8ft in diameter and can deliver 50,000 g.p.m. to each set. Two circulating water pumps are required per unit, these being by Mather & Platt and rated at 700 h.p., 600-590 r.p.m. on a 3·3 kV supply, and can deliver 27,500 g.p.m. each.

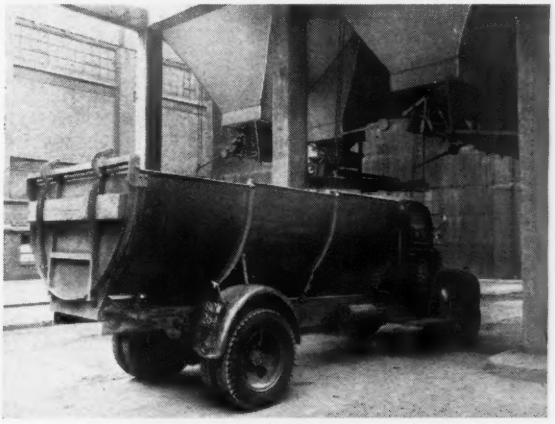
With two machines in use, four boilers have been completed. The finished station will contain seven boilers to feed four sets, three boilers being capable of supplying two sets on full load. The boilers are of the high head natural circulation radiant heat type with pulverized fuel firing and capable of generating 360,000 lb of steam per hr at 950 lb/sq in and 925 deg F. Lighting of the boilers is by pressure jet atomization of oil, two burners being installed in each of the two opposite corners of the boiler and having a capacity of 600 lb/hr each burner. Bunker capacity is 540 tons per boiler and coal supply is to three "Lopulco" LM14 mills whose output is controlled by the variable speed feeders on the floor above. Each mill feeds four p.f. burners in the four corners of the boiler. The total heating surface of the boiler is 8,800 sq ft and the combustion chamber is 24ft 6in wide by 23ft deep by 53ft high, giving an active volume of 25,450 cu ft. "Melesco" self-draining superheaters are installed having a heating surface of 6,250 sq ft on the primary, 6,250 sq ft on the secondary and 2,600 sq ft on the tertiary. "Senior" economizers and Ljungstrom air pre-heaters are installed. Associated with each boiler are two forced draught fans requiring 134 h.p. and delivering 51,300 cu ft of air/min at m.c.r., two induced draught fans requiring 231 h.p. and delivering 81,200 cu ft/min at m.c.r., and three exhauster fans for the pulverizing mills each driven by a 240 h.p. motor. Thirty-five soot blowers are used on each boiler.

Five feed pumps, all of 100 per cent rating for one set, are provided for the first half of the station. Three of these are electric and two steam and all deliver 1,063 g.p.m. against a head of 2,907ft, both the motors and the turbines being rated at 1,380 h.p. at 2,960 r.p.m.

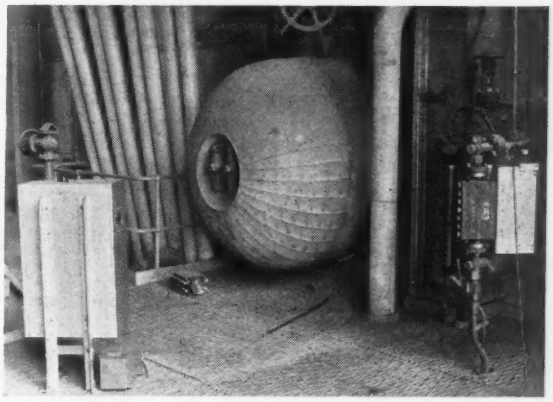
"Electroflo" pneumatic equipment is installed for the automatic control of the boiler and a further advance in instrumentation was seen during our visit as an experimental arrangement was being set up by Hopkinsons, Ltd., to provide televised viewing of the boiler drum water



The pneumatic dust plant from the outside



Telescoping lorries for ash slurry disposal



Hopkinson television monitoring of boiler water level

gauge-glass. We have illustrated the equipment in one of our photographs in which the box on the left houses a television camera, simplified in that it does not scan completely in two dimensions but only sufficiently for the vertical line of the gauge to be covered. On the right, mounted behind the existing water level, is a powerful illuminating source. The image is intended to be relayed to a screen mounted on the boiler panel. This arrangement is purely experimental and will not necessarily be installed finally in this power station but we feel it will be of interest.

Associated with each boiler is a dual precipitator having eight dust hoppers capable of holding 20 hours' precipitation at m.c.r. with a guaranteed efficiency at this rating of 98 per cent. The guaranteed efficiency of the boilers on full load is 82·2 per cent.

Ash Plant

Furnace ash is conveyed by hydraulic sluice to an ash sump holding about 130 tons from which a telpher grab removes the solid matter into bunkers which discharge to "Jekta" type road lorries. These lorries have three sections which telescope together for ejection by means of a hydraulic ram behind the cabin, and one of them can be seen in a photograph. Trouble has been experienced with this part of the plant due to sticking at the bunker outlets and to freezing of the wet ash in winter.

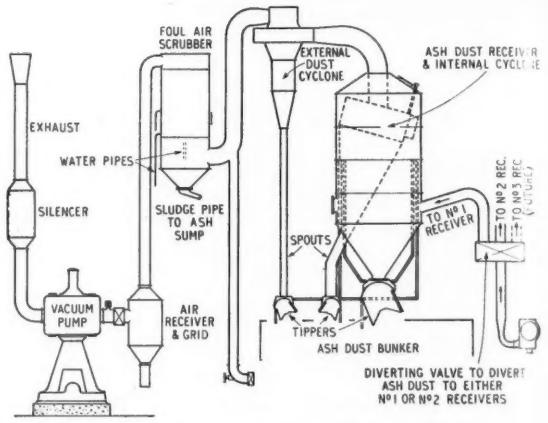
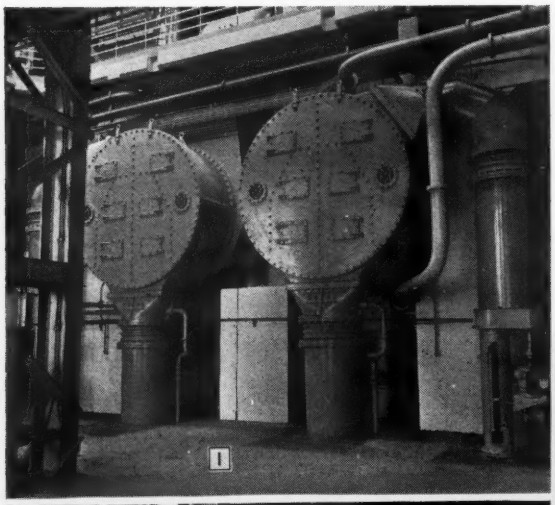
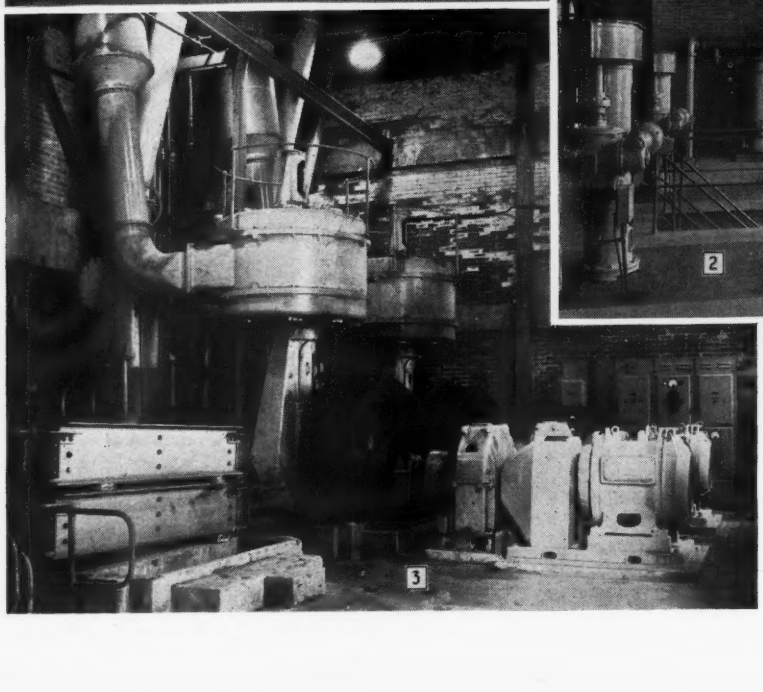


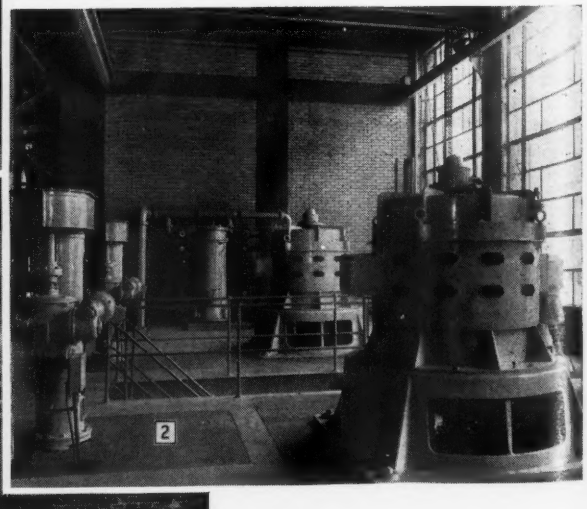
Fig. 2.—Pneumatic ash dust handling plant

For the second half of the station a grab will remove ash from a sump on to a drainage platform from which another grab will load it on to a lorry.

Dust and grit from the precipitators, air heaters, economizer and chimney is conveyed by vacuum extractor to dust receivers. The way in which the vacuum extraction plant works is illustrated in Fig. 2. The pipe on the extreme right leads away to all dust sources and sucks the dust into a manifold from which it can be guided







(1) *Twin condensers of No. 2 set*

(2) *Two cooling water pumps are in the foreground and generator transformer oil coolers against the wall*

(3) *The two vacuum pumps of the ash plant*

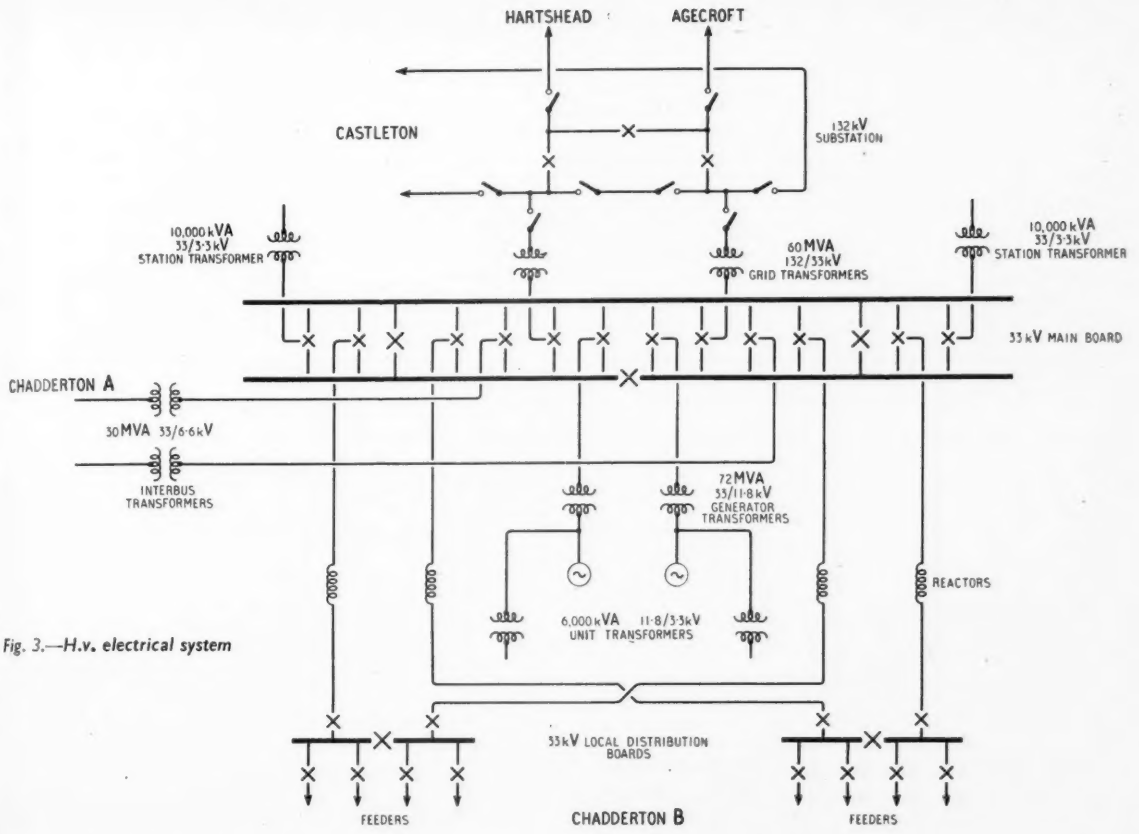


Fig. 3.—H.v. electrical system

into any of the three receivers. On entering an ash dust receiver, owing to the sudden expansion and consequent lowering of the air velocity the greater portion of the ash dust is deposited. The coned bottom section of the receiver leads this deposited dust into the tipper seals which feed it into steel storage bunkers without breaking the vacuum within the receiver. The conveying air, having been separated from the main bulk of the dust, is subjected to two cleaning actions, first in the internal cyclone and then in the external high-speed cyclone, the collected dust from both of these being led to the bunker by further tipper seals. The conveying air will still contain a minute quantity of dust which is passed to a foul-air scrubber in order to cleanse it of the particles. Clean air passes on to the air receiver which serves the dual purpose of damping the pulsations of the vacuum pump and also, by virtue of the fact that it has a perforated metal grid inserted between the inlet and outlet, forms an additional safeguard for the pump. A vertical double acting reciprocating pump draws the conveying air through the system and exhausts it to atmosphere.

The two dust storage bunkers have a total capacity of 260 tons and feed into screw type mixers where water is added before delivery into the disposal lorries. Even this has been found insufficient to prevent considerable dust clouds as the hoppers discharge and experiments are being carried out with a ring of water sprays wetting the dust as it emerges from the hopper on to the lorry.

The complete station will contain four hydrogen-cooled 60 MW Metropolitan-Vickers turbo-alternators. The first two are 3-cylinder machines having eleven high-pressure stages, fourteen intermediate-pressure stages, and three stages plus a multi-exhaust stage in each direction on the low-pressure side. The second two machines will be of the twin cylinder type. All have a duplex exhaust, are of the impulse type and run at 3,000 r.p.m., under steam conditions of 900 lb/sq in and an inlet temperature of 900 deg F.

There are two low-pressure and two high-pressure feed water heaters for each machine and a de-aerator, and the final feed water temperature is 380 deg F. Turbovisory gear on the gauge panel gives chart records and continuous indication of differential expansion and shaft eccentricity, this being found invaluable to the station staff once they had become fully acquainted with its use. Steam is exhausted to two-pass shell condensers with a designed vacuum of 28·7in of mercury. There are two electrically driven condensate extraction pumps for each machine, each capable of handling the full quantity.

The alternator is usually run with hydrogen at about 1·5 lb/sq in pressure, the total volume of gas space being 1,350 cu ft. Under normal run-

The flexible mounting of the hydrogen coolers in the stator

ning conditions a small amount of hydrogen has to be made up each week and the cost of this make-up for one set works out at about £1 a week. The hydrogen in this type of machine is cooled by finned tubes run inside the stator, the entry and exit being through special plates at one end and the fixing on to special plates at the other end. We have shown in one of our photographs the outside of one of these fixing plates, which is of interest because of the way in which it is built into the main stator endshield. The expansion of the cooling pipes under load conditions may be slightly different from that of the stator as a whole and to allow for this these special plates are bonded into the main endplate by rubber vulcanized into position. This has to stand up to the hydrogen pressure inside and care has to be taken to ensure that no leakage can take place through imperfect sealing.

Mr. F. Dewhurst, station superintendent

Fig. 3 shows the principal electrical connections. The first two sets generate at 11·8 kV and feed via 72 MVA generator transformers on to 33 kV, 1,500 MVA Ferguson Pailin switchboards. These are of the vertically isolated phase segregated design arranged for off-load busbar operation by the physical transfer of the circuit-breaker. Central facilities for the power-factor testing of bushings *in situ* are provided and also arrangements for closing the circuit-breakers by means of rectifiers as an alternative to the main station battery. Two 500 MVA, 33 kV single busbar distribution switchboards are connected by four circuits through group reactors to the main 33 kV board. The second two generators will connect via 11·8/132 kV 72 MVA transformers direct to the grid, outdoor bulk oil type 132 kV switchgear being added to the existing grid substation. The control room is situated in the administrative block connected to the station by a bridge and has corridor type control panels by Ferguson Pailin.

Chadderton "B" has an efficiency under good conditions of about 29·2 per cent and is run at present as a three-shift station. It has a very high local 33 kV load, the maximum demand of which to date has been 91,200 kVA, or more than three-quarters of the present output. The second half of the station is being designed with a view to future two-shift working when the very large base load stations now being planned come into operation.

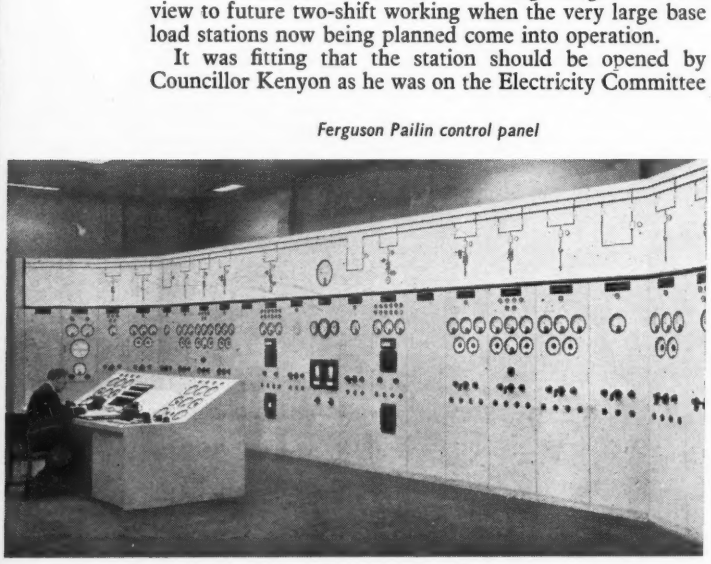
It was fitting that the station should be opened by Councillor Kenyon as he was on the Electricity Committee concerned with building the first Chadderton station in 1929. In officially opening the station by the unveiling of a plaque he said that when the earlier station had been opened the actual cost worked out at less than £13 a kW and coal was 15s a ton. The latest station had cost about £70 per kW and coal was now 65s a ton. During that time, however, the average receipts per unit sold had increased by only $\frac{1}{6}$th of a penny. That was a measure of the improvement in efficiency, and all concerned could be proud of it.

Mr. Geoffrey F. Kennedy spoke on behalf of the contractors and consulting engineers and recalled that the first power station to be built in Oldham, in the 1890's, was designed by his grandfather Sir Alexander Kennedy who was also responsible for the Greenhill station in 1903.

We are indebted to the Central Electricity Authority, to Mr. A. R. Cooper, divisional controller, North West, Merseyside and North Wales Division, and to Mr. F. Dewhurst, station superintendent, for permission to publish this account and for their assistance.

The consulting engineers for the station are Kennedy & Donkin, the associated consultants for the civil engineering works being Mouchel & Partners, Ltd. The principal contractors are Simon Carves, Ltd., for the boilers, ash and coal handling plant and precipitators; the Metropolitan-Vickers Electrical Co., Ltd., for the turbo-generators, etc., and for the principal transformers; Ferguson Pailin, Ltd., for the 33 kV switchgear; Mather & Platt, Ltd., for the circulating water pumps and boiler feed pumps; the English Electric Co., Ltd., for 3·3 kV switchgear; and Enfield Cables, Ltd., for the main, auxiliary and control cables.

Ferguson Pailin control panel



LETTER TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Scientific Libraries

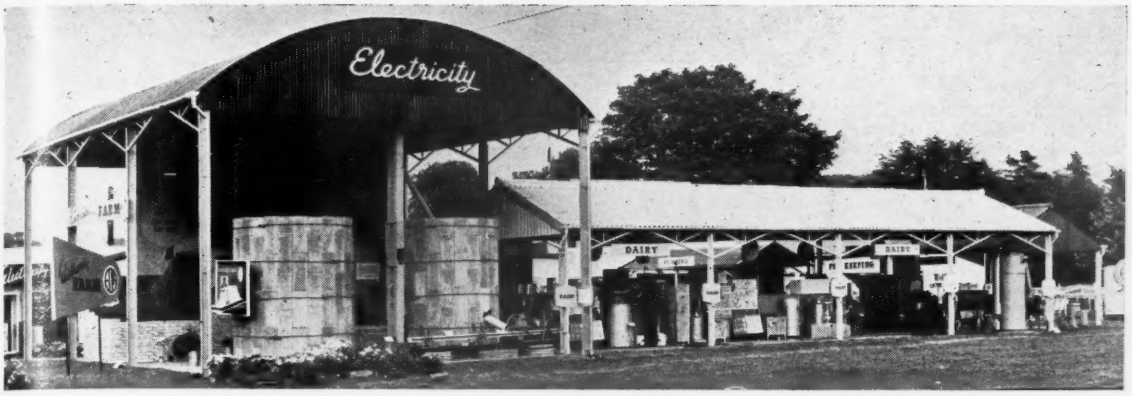
THE article on this subject by R. Roberts in the *Electrical Review* of 24th June contains a reference to the Science Museum which, by its omissions, may give a quite false impression of the services which the Science Museum Library (frequently referred to as the "Science Library") offers. In particular, no reference is made to our loan and photo-copy service, which constitutes one of the most valuable of the Science Library's services to science and industry. In 1954 over 100,000 requests for loans were received and over 30,000 photo-copy requests were satisfied.

You may think the following details worth bringing to the notice of your readers:—Total number of volumes to date, over 400,000; total number of scientific and technical periodicals, 22,000 titles current and non-current (of these 8,500 are current and are catalogued in our "Handlist of Short Titles of Current Periodicals in the Science Library," H.M. Stationery Office, price 10s net, 10s 5d by post).

The author's reference to "an index of scientific books and periodicals in general" is obscure and seemingly inaccurate. The Library maintains both author and subject catalogues of its own holdings and the reading room is well equipped with bibliographical material in general, including a copy of the published book catalogue of the British Museum Library in addition to purely scientific and technical reference works.

South Kensington, S.W.7.

D. CHILTON,
Publicity Officer,
Science Museum.



THE ROYAL SHOW

Electrical Exhibits for the Farmer

FROM an electrical point of view the main exhibit at the Royal Show held last week at Wollaton Park, Nottingham, was that organized jointly by the British Electrical Development Association and the East Midlands Electricity Board. Separate sections were devoted to the application of electricity to the dairy, pig and poultry keeping, water pumping, animal food preparation, handling and milling grain, crop conservation, the farm workshop and to the farmhouse itself.

In the dairy section there was a representative selection of electrical equipment for supplying hot water, steam raising and the milk cooling requirements of dairy farmers and in each case typical operating costs were displayed. While the equipment shown was representative of every aspect of electricity in modern farming activities, particular attention was paid to the small mixed farms, and in the pig-keeping section a selection of equipment was shown for heating the floors of piggeries, the warming of piglets by infra-red heaters and for cooking pig food. Incubators of various sizes, heated chick rearers and equipment for providing extended lighting to increase egg production were included in the poultry section. Examples of automatically operated milling machines, together with food mixers, mincers and cooking appliances for all kinds of stock were also shown.

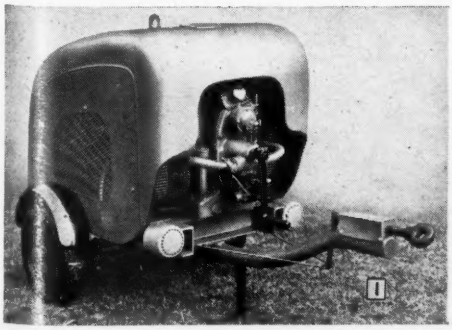
How easily the farmer can become independent of a mains water supply was demonstrated in the water pumping section where there were several different types of electrically operated pumps suitable for rural applications, with diagrammatic layouts of typical installations.

The crop conservation section contained several full-scale plants, including in-silo and platform grain dryers, mechanical grain handlers and the latest multi-purpose grain/grass dryer evolved by the Electrical Research Association. The last-mentioned item is a development of the well-known platform grain dryer and may be used for grain and green crops such as wilted grass, lucerne and legumes.

The farm workshop is assuming an ever-increasing importance and demonstrations of electric arc welding and the uses of electrically powered tools such as drills, sanders, polishers, grinders and soldering irons indicated the time and labour saving values of such appliances. For the farmer's wife, the home and garden section showed a wide range of electric cookers, water heaters, refrigerators and laundry equipment. A full-sized greenhouse on show was provided with space heating and soil warming equipment and there were soil warming frames for growing and propagating purposes.

Another comprehensive array of electrical equipment was to be seen on the General Electric Co.'s stand where a complete range of apparatus for a farm included items for dairy farming, pig warming, poultry rearing and domestic appliances. A new greenhouse heater with a

(1) A. C. Morrison 150-200 A d.c. portable welding set. (2) G.E.C. greenhouse heater. (3) British Thomson-Houston Co. "Stavolt" alternator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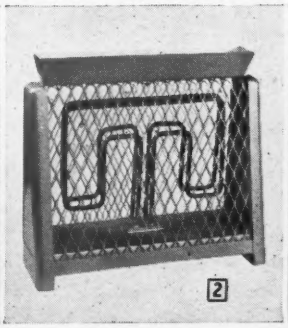
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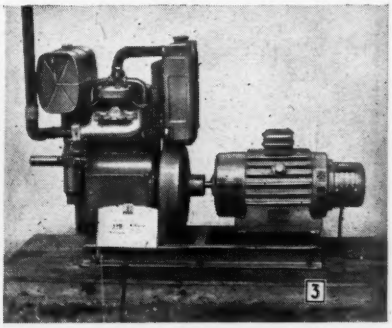
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loading of either 750 W or 1,500 W was shown for the first time. On top of the heater is a galvanized water trough so that the humidity of the greenhouse can be raised if required. Among infra-red heaters for pigs and poultry were single-lamp and two-lamp units.

Dairy equipment included a water storage steam raiser, sterilizing chests, steaming unit, a dairy water heater and a farm food cooker working on the same principle as a domestic pressure cooker. This company's horticultural section also contained electrically heated sterilizers, warming cables, air thermostats and waterproof tubular heaters specially designed for greenhouses. The latest G.E.C. plant irradiator employing an "Osram" high-pressure mercury vapour lamp was also to be seen. Among the domestic appliances was the G.E.C. cooker fitted with an "auto-timer" and a selection of refrigerators included a 3 cu ft model in the new honeysuckle colour as well as the 5 and 8 cu ft models.

Visitors concerned with agricultural plant and machinery found much to interest them on the British Thomson-Houston Co.'s stand where there was a comprehensive exhibit of electrical equipment including motors, starters and control gear, and "Pyrobar" electric heaters for single- and three-phase a.c. supplies. A working exhibit of interest was the "Stavolt" close-regulation alternator which has been developed by B.T.H. for providing a.c. supplies to isolated communities and agricultural areas. In the demonstration the alternator was driven by a diesel engine and was being used to supply other working exhibits on the stand to show its stability under widely varying loads. Modern farm machinery incorporating electric motor drives included incubators, a water pump, milking machines, a milk cooler and in-sack grain dryer and sheep shearers, all driven by B.T.H. f.h.p. motors, while larger motors were shown driving a continuous grain dryer, grain elevator, sack elevator, and a "Winnograder." On the lighting side there was an ingenious scale model of a farm demonstrating lighting in various buildings.

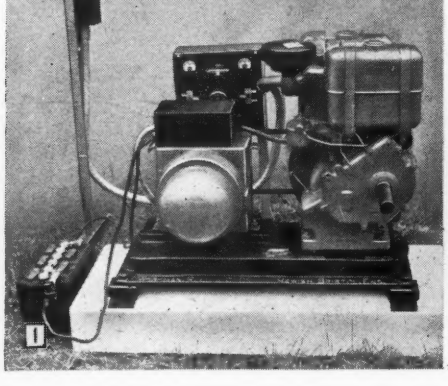
A large number of fixed and mobile generating sets were on view and at the stand of A. C. Morrison (Engineers), Ltd., the representative selection ranged from the 350 W a.c. "Minor" (small enough to be carried by a girl) to a 40 h.p. power "Mule." One of the most interesting of these was the Morrison mobile electric arc-welding set. Trailer-mounted, this 150-200 A d.c. set is claimed to weld practically all metals and alloys and is ideal for carbon arc applications. Workman, Reed & Co., Ltd., manufacturers of the smallest diesel-electric generating plant, now include a 1,500 W set in their range. Fully automatic, it is fitted with the new 3 b.h.p. Lister air-cooled engine and is suitable for operating the majority of standard electrical appliances on the farm. Milking machines can also be driven from the engine shaft. Lighting and starting equipment for agricultural tractors and stationary engines were shown on the C.A.V. stand together with dynamos with control gear, engine starters, etc. In addition to a full range of farm machinery and dairy equipment the display on the Lister-Blackstone stand includes the TS3 diesel engine now manufactured as an industrial power unit by R. L. Engineers, Ltd. The engine was seen as an integral part of a lighting and pumping set. The generating set incorporating the TS3 is direct coupled to a fully compensated self-regulating 40 kW, 400/230 V three-phase 50 c/s alternator.

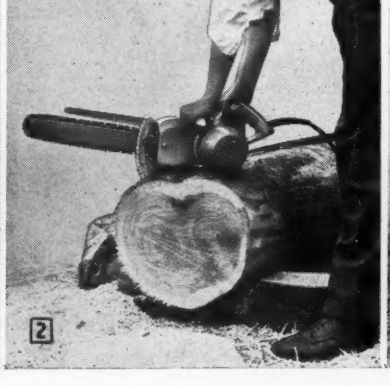
A special domestic electric pump for shallow wells has been developed by Thomas & Son (Worcester), Ltd., using a $\frac{1}{6}$ h.p. motor. It has an output of 110 gal/hr, the total head being 80ft. Another model incorporates a $\frac{1}{4}$ h.p. motor with a similar output and a total head of 100ft. The speed is 260 r.p.m.

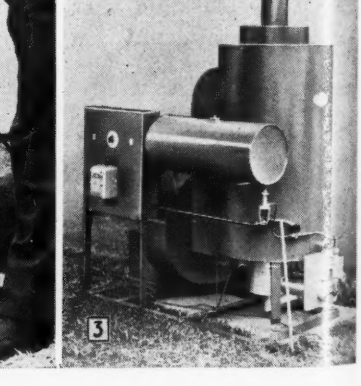
Among a large collection of refrigeration equipment Marco Refrigerators had on view commercial refrigerators, bottle coolers, fish cabinets and counter display units. Prestcold models included home freezers, domestic refrigerators, a range of conservators, service cabinets and condensing units. There was also on show a coldroom with the newly introduced UCL type cooler and a farm tank as in use for the bulk milk collection scheme. A full range of refrigeration equipment was also shown by York Shipley, Ltd., and J. & E. Hall, Ltd.

Claimed to be the first of its kind, the new Woolley "Electrohot" wash trough for bottle washing purposes automatically maintains the temperature of the washing water during the operation no matter how long a time is taken or how cold the bottles may be. It is suitable for a single-phase a.c. supply and has a loading of 3 kW, and is thermostatically controlled. This company also displayed a new in-bin grain dryer employing the heat exchange principle. It incorporates an oil-fired burner developed by Joseph Lucas, Ltd., in collaboration with J. W. Woolley & Co., and the fan is powered by a 3 h.p. motor. The apparatus will be available in a number of sizes.

(1) Workman, Reed & Co.'s 1,500 W generator. (2) Danarm portable 9 to 12in electric saw. (3) J. W. Woolley in-bin grain dryer







Electric fence equipment was shown by the Wolseley Sheep Shearing Machine Co., Ltd., and the Cooper-Stewart Engineering Co., Ltd., together with horse and cattle clippers and de-horning equipment. The "Invincible" cattle de-horner (J. McCubbing) is specially designed for de-horning calves by means of an electrically heated searing iron at low voltage. It can be supplied either from a mains transformer or car battery. Nield's Patents, Ltd., manufacturers of electric fencing posts and insulators, have now strengthened their range of "Lok" insulators with steel inserts and these have been tested to withstand up to 50 kV without leakage.

For poultry farmers who do not wish to raise more than 500 chicks at a time Western Incubators, Ltd., have developed the 3B broiler brooder which has all the qualities of the larger models. The answer to cannibalism and feather picking amongst a flock may be found in the use of the Visi-Chick electric de-beaker. A prototype of a portable electric saw was exhibited by Danarm, Ltd. Capable of a 9-12in cut it is powered by a 1 h.p. motor with a speed of 4,200 r.p.m.

Altogether over 200 trade stands were supplied with lighting and power installations by Dale Electric. Some 53 miles of cable, including overhead and underground types, were laid and three substations installed, two of 500 kVA and one of 300 kVA.

NEW BOOKS

Circuits and Networks. By Glenn Koehler. Pp. 349; figs. Macmillan & Co., Ltd., St. Martin's Street, London, W.C.2. Price 45s 6d.

Network analysis is now a common subject in many electrical engineering courses and this book is based on a series of lectures on circuits and networks given by the author at the University of Wisconsin.

A knowledge of alternating current theory is assumed, and the first two chapters provide a revision of that knowledge. Phasor, or vector as it is more commonly described in this country, algebra, mesh current and nodal voltage methods for solving networks, and network transformations and reductions are briefly described. The second chapter outlines the usual network equations—reciprocity, superposition, Thevenin, Norton, maximum power transfer, and compensation theorems.

The properties of frequency selective networks, both series and parallel types, are presented from the communication aspect, explaining such terms as band width, voltage selectivity, and Q factor. The A.B.C.D. parameters of four-terminal networks start a chapter on impedance matching of such networks. Filter circuits are classified, and divided into constant k, m-derived, and composite types. Attenuators and equalizers form the subject of a further chapter.

Transmission line theory is given in general terms and an analysis presented which may be used at any frequency. A separate chapter is devoted to the operation of transmission lines at high frequencies, including travelling waves and delay lines. The last chapter, on transformers and reactors, stands apart from the rest of the book giving a survey of the equivalent circuits of this equipment and their analysis. The book covers the subject matter of network analysis as studied in the final year of undergraduate courses in electrical engineering.—K.W.W.

Electric Traction Engineering. By E. A. Binney. Pp. 224; figs. 57. Cleaver-Hume Press, Ltd., 42a, South Audley Street, London, W.1. Price 15s.

The publication of authoritative works on the subject of electric traction has been a rare event in recent years, and young engineers entering this specialized field have been unable to study books covering the basic knowledge required to practice their art. In this volume, in a readable style essentially from a practical engineer's outlook, the vital basic theory is well covered.

Systems of electric traction are fully discussed, without entering into the complicated and often controversial subject of economics. The history of electric traction is traced from its earliest experimental beginnings, while the author's views of the future possible systems of power transmission to the locomotors will provoke discussion.

The three main headings under which electric traction is studied are adequately covered. As would be expected in a book from Mr. Binney's pen, traction motors receive the fullest consideration. The subjects of "traction control" and "project engineering" are each dealt with in one chapter. Bearing in mind the nature of the book, this is just sufficient.

The chapter "Traction Engineering in the Industry" must be unique. A large proportion of those professionally employed in electric traction must, of necessity, be concerned with manufacture. This chapter, although applying to one company only, serves to give the student and new entrant a very clear idea of the work he may expect to carry out, and the ends which he should achieve.

The production of this little book is good, the line drawings and diagrams being exceptionally clear and easy to read. It is perhaps a pity that the author has chosen his wide and interesting selection of photographic illustrations almost entirely from the products of one manufacturer, his employers.

Altogether a most valuable and welcome addition to the very limited literature on the subject, this volume can be thoroughly recommended to all students and young engineers who have or intend to become engaged in this branch of engineering. Such is the value of the contents that some more experienced engineers, especially those concerned mostly with commercial aspects, will find it useful as a refresher course.—R.N.

BOOKS RECEIVED

Electromagnetic Principles of the Dynamo. By E. B. Moullin. Pp. 367; figs. Geoffrey Cumberlege, Publisher to the University, Oxford University Press, Amen House, Warwick Square, London, E.C.4. Price 50s.

Lignes Electriques T.H.T. By H. Carpentier. Pp. 250; figs. Editions Eyrolles, 61, Boulevard Saint-Germain, Paris Ve, France.

Elementary Engineering Mechanics. By J. B. Thirlwell, B.Sc.(Eng.). Pp. 126; figs. Macdonald & Co. (Publishers), Ltd., 16, Maddox Street, London, W.1. Price 10s 6d.

Radar and Electronic Navigation. By. G. J. Sonnenberg. Pp. 288; figs. 217. George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 31s 6d.

Dictionary of Television, Radar and Antennas. By W. E. Clason. In English/American, French, Spanish, Italian, Dutch and German. Cleaver-Hume Press, Ltd., 31, Wright's Lane, Kensington, London, W.8. Price £6.

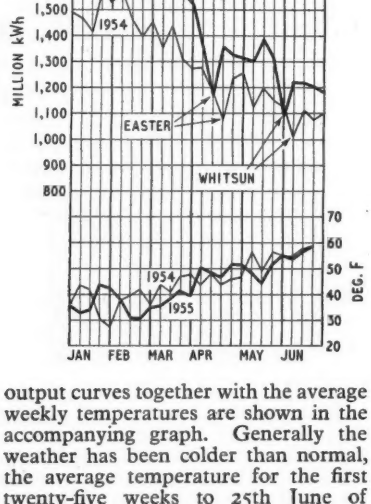
Magnetic Control of Industrial Motors. By G. W. Heumann. Pp. 714; figs. Chapman & Hall, 37, Essex Street, London, W.C.2. Price 86s.

A Guide Book to Electricity. By J. H. M. Sykes, Assoc.I.E.E. Pp. 275; figs. Hutchinson's, Stratford Place, London, W.1. Price 21s.

GENERATION AND DEVELOPMENT

Output of Solid-Fuel Stations

A total of 37,804 million kWh was sent out for public supply from solid-fuel-fired generating stations in this country during the first twenty-six weeks of the year. This compares with 33,820 million kWh in the corresponding period of 1954, an increase of 11·8 per cent. Weekly



output curves together with the average weekly temperatures are shown in the accompanying graph. Generally the weather has been colder than normal, the average temperature for the first twenty-five weeks to 25th June of 43·8 deg F comparing with 45·2 deg last year and an average figure of 46·2 deg for the thirty years 1921-50.

Little Barford "B" Power Station

The Central Electricity Authority has received the consent of the Ministry of Fuel and Power to the extension of the Little Barford power station, near St. Neots, by the establishment of a new section to be known as Little Barford "B." The present station has an installed capacity of 120 MW. The extension will provide a similar capacity by two further 60 MW turbo-generator sets and two boiler units each having an evaporative capacity of 550,000 lb/hr.

Supply in Wester Ross

Electricity supplied by the North of Scotland Hydro-Electric Board was switched on for the first time at Applecross, Wester Ross, on 9th July. The actual switch-on, making power finally available to the area, was performed by Mr. Kenneth Ferguson, an 88-year-old local inhabitant, who was presented with an electric kettle. Speaking at the ceremony, Sir Hugh Mackenzie, C.B.E., deputy chairman of the Board, said it has been suggested once or twice recently that the Board's schemes for development might be frustrated unless something was done to remedy the high costs of distribution. High these costs undoubtedly were, but they were offset to a considerable extent by the fact that the Board's water power production costs were somewhat lower than the steam costs of the rest of the country. The result was that the average price per kWh paid by the Board's consumers was lower than that paid in London and lower than the price paid by 40 per cent of the rest of England. The Board's charges had not gone up since 1952.

Mr. Thomas Lawrie, C.B.E., general manager of the Board, said it was to be hoped that before long an atomic power station would be built in the Board's Area but it was to the further development of hydro-electric power that the Highlands must look for abundant electricity.

Electricity and Scottish Economy

Within the next few years Scotland hoped to be generating electricity from peat, said Lord Strathclyde, Minister of State for Scotland, in Edinburgh last week. Speaking at a function to inaugurate the new South of Scotland Electricity Consultative Council, he said that clearly much of their future prosperity depended on the development of new industries making wide use of electricity in new ways. "We have only recently made a start with the development of the electronics industry, and in the next few years this may well provide Scotland with new industrial 'growing points' of vast economic importance to the United Kingdom."

Mr. J. S. Pickles, chairman of the Board, said that in 1948 5,300 farms were receiving a supply of electricity. To-day the number was 10,700. In seven years there had been connected as many farms as in the previous fifty years.

Progress of St. Lawrence Project

After a recent tour of the St. Lawrence power project area Dr. Richard L. Hearn, chairman of the Ontario Hydro-Electric Power Commission, said that work was well advanced on all stages of the scheme west of Cornwall. Following completion of de-watering of the power-house area an "immediate start" was being made on the removal of 2 million cu yd of earth at the power-house site. In early October drilling and blasting would be started for the removal of 125,000 cu yd of rock. This operation would clear the way for the pouring of the first concrete for the power-house itself, which was scheduled to begin early next year. Dr. Hearn said a total of more than $61 million in contracts had already been awarded for the various parts of the project.

Reinforcement Scheme

The South of Scotland Electricity Board has approved a scheme for the reinforcement of supply to Newton Mearns, including the construction of two new substations, one in Beech Avenue, near Shaw Road, and the other in Firwood Road at Oakwood Drive. The work will cost over £16,000.

Power from the Congo

At a recent Press conference (states *West Africa*) the Belgian Minister of Colonies, M. Buisseret, referred to the vast possibilities for hydro-electric development along the River Congo between Léopoldville and Matadi. One particularly promising site for a power station was Inga.

Turkish Hydro-Electric Scheme

A hydro-electric power plant with a capacity of 15,000 kW is to be built at Kepez, in the Province of Antalya, Turkey. To finance the project a company has been formed by the Etibank group.

Wolverhampton Transport Results

A gross surplus of £139,972 on the trolley-buses and a deficiency of £6,013 on the motor-buses were shown in the accounts of the Wolverhampton Transport Department for the year ended 31st March last which were submitted to the Town Council on 27th June. After meeting all charges the net result was a deficiency of £2,821 against a surplus of £26,277 for 1953-54. In its report the Transport Committee attributed the adverse result partly to reduced traffic and bad weather, but mainly to increased costs.

Statistical information submitted by the Committee showed that during the year under review the rolling stock comprised 153 trolley-buses and 138 motor-buses, there being an average of 128 trolley-buses and 114 motor-buses in service each day. The average journey per day for vehicles in service was 121 miles for trolley-buses and 115 miles for motor-buses. The total vehicle mileage for the year was 10·4 million and the passengers carried by the two types of vehicles totalled more than 117·6 million. The Committee recorded its appreciation of the services rendered by the general manager (Mr. R. H. Addlesee) and all the staff and employees of the Department during another difficult year.

Trolley-buses in Newcastle

Newcastle-on-Tyne Transport Committee is to interview the Ministry of Transport on the question of running trolley-buses along Silver Lonnen.

INDUSTRIAL NEWS

Export Licensing Control

Changes in export licensing control are made in the Export of Goods (Control) (Amendment) Order, 1955, which came into force on 14th July. Under the new Order licences will be required for the export to all destinations (other than the British Commonwealth, the Irish Republic and the United States) of specified cables, specified cable-making machines, certain generators, turbo-generators, motor-generating sets and synchronous condensers and specified line communications transmission equipment. Copies of the Order can be obtained from H.M. Stationery Office, price 4d (by post 5½d).

Canadian Telephone Cable Company

The formation of Telecables & Wires, Ltd., to manufacture in Canada a complete range of telephone wires and cables brings together the telecommunications engineering experience of Canadian, British and American cable companies. Jointly owned by the Canada Wire & Cable Co., Ltd., the General Cable Corporation of New York and the Telegraph Construction & Maintenance Co., Ltd., of Great Britain, the new company will be managed by the Canada Wire & Cable Co. The municipality of Fort Garry, a suburb of Winnipeg, Manitoba, has been selected as a suitable location for the new plant, where an option on a site has been arranged pending determination of foundation conditions. Plans are now being prepared for the early commencement of this plant. It is proposed that the board of Telecables & Wires, Ltd., shall be as follows:—Messrs. I. T. Bennett (chief executive officer, General Cable Corporation); J. R. Bradfield (president, Canada Wire & Cable Co., Ltd.); J. N. Dean (chairman, Telegraph Construction & Maintenance Co., Ltd.); L. G. Lumbers (vice-president, Canada Wire & Cable Co.); J. R. MacDonald (president, General Cable Corporation); and O. W. Titus (vice-president and general manager, Canada Wire & Cable Co.).

Chinese Industrialization

Last week an ambitious programme of industrial development was announced by the Chinese Government. The work is to be spread over five years and will include the stepping-up of coal, steel and cotton textile production. It is proposed to harness the power of the Yellow River by constructing a number of dams, reservoirs and power stations.

Atomic Power for Australia

A *Reuter* message from Sydney reports that representatives of three large British companies announced on 5th July that they had formed a group for the construction of atomic power stations. The group consists of the English Electric Co., Babcock & Wilcox, Ltd., and the Taylor Woodrow Companies.

Training Foremen

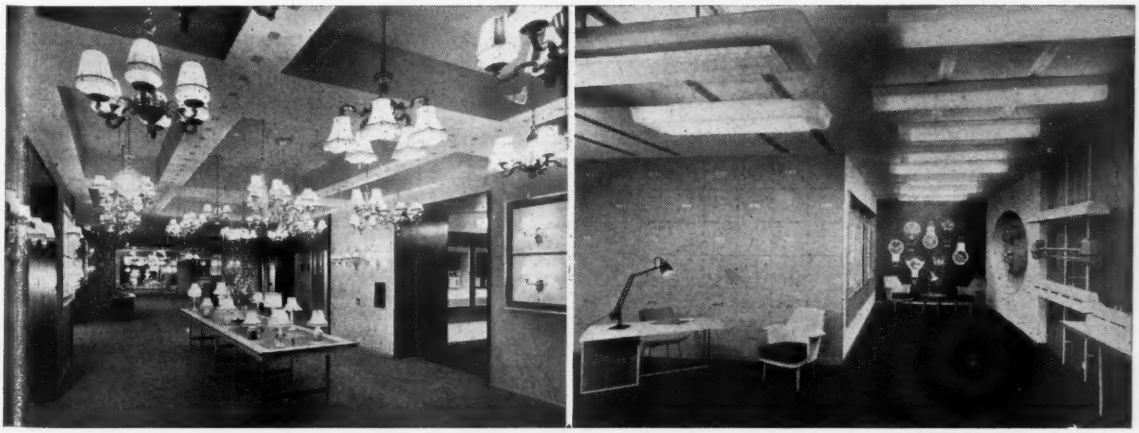
Woods of Colchester, Ltd., has formed a Foremen's Association to enable everyone at that level to get together to discuss problems and methods, and make recommendations. Lectures are given periodically by visiting speakers or company executives, and visits are made to other concerns and to engineering exhibitions. A foreman's handbook, issued recently, gives an authoritative reference to company procedure, foremen's responsibilities, works rules, welfare matters, and the Factories Act. As an extension of this policy the company has introduced a new scheme which will prepare selected chargehands for foremen's positions as vacancies occur. Under the scheme the chargehand makes a three-month circuit of all production departments and then he has a month's instruction on the commercial aspects of manufacture. In addition arrangements are made for him to attend courses organized by the Industrial Welfare Society where he has the opportunity of discussing problems with foremen from other concerns.

New G.E.C. Lighting Showrooms

In the new London lighting showrooms of the General Electric Co., Ltd., at Magnet House, Kingsway, every style of lighting fitting, from early Elizabethan to contemporary, is represented against an appropriate background. This effect has been achieved without the showrooms seeming to be divided into several small independent rooms.

The traditional room has been decorated in rich, regal colours to give a setting appropriate to the fittings. The chandeliers include traditional patterns of the Flemish, Stuart, Restoration, Georgian, Adam and crystal styles, as well as the ornate ormolu chandeliers of the French school. The fittings are hung in coffers which are finished in pale blue with gilt risers, and the richly papered walls, green velvet curtains and crimson carpet provide an atmosphere completely in keeping with the rich ornament and finish of the fittings. A long central table has table lamps and a large illuminated bowl of flowers. Open arches lead into a room

The traditional room and the display of fluorescent fittings in the G.E.C. lighting showrooms at Magnet House, Kingsway, London



devoted to the more general types of domestic fittings. One wall has four alcoves arranged to show various types of fittings in appropriate domestic settings.

On the other side of the traditional room another opening leads into an area devoted to the display of fluorescent fittings of all kinds, with eight recessed showcases. Particular attention has been paid to the provision of means for demonstrating both the colour rendering and the colour appearance of the tubes. The main archway from the traditional room leads into the contemporary room, where are displayed all the new fittings introduced this season. The device of a series of small furnished alcoves is repeated in this room, among the many novel features of which may be mentioned large mirror-backed alcoves for displays of table lamps and pendants; a central tubular display stand carrying illuminated fittings; and a slab suspended from the main ceiling composed of tiles covered in black leatherette, each one carrying a ceiling fitting in the centre. Finally, a half-timbered room is devoted to wrought iron and wood fittings of the Elizabethan style. Beverley Pick Associates were responsible for the layout and decor of the new showrooms.

New Edinburgh Service Centre

A new service centre of the South of Scotland Electricity Board (Edinburgh Area) was opened on 28th June at 130, George Street, Edinburgh. This represents the first instalment of a reconstruction programme being undertaken by the Board in premises acquired in one of the main shopping centres of the city. The showroom has been designed by Gordon & Dey, architects, and incorporates many contemporary features. The general decor has been treated on a semi-exhibition basis, which allows for flexibility in display and good use has been made of lighting for attracting attention to particular displays. There is an extensive platform, which for the time being will be used for demonstrations, and later, when the extensions are completed, this will be suitable for assembled audiences. The platform has a specially designed stand for demonstrating electric cookers, which includes a meter calibrated in pence.

The new service centre opened in Edinburgh by the South of Scotland Electricity Board

The National Register

Among the articles in the June issue of *Registration*, the official review of the National Register of Electrical Installation Contractors, is one by Mr. H. W. Swann, O.B.E., called "Press Cuttings." It relates to Press reports of electrical accidents of a variety of types, with a commentary. This issue also gives particulars of the new National Inspection Council and questions and answers on the I.E.E. Wiring Rules.

Rheostatic Conference

The Rheostatic Co., Ltd., recently held its second international conference which was attended by twenty delegates representing associated companies and agents from fourteen countries overseas. The proceedings opened with a speech of welcome from the chairman, Mr. M. J. Gartside, after which the delegates visited the recently completed building at the Slough works which now houses the Engineering and Technical Development Departments. Several papers were presented by executives of the company on various technical subjects generally dealing with the applications of the company's equipment, and the development of new instruments. A visit was paid to London Airport where the delegates were shown by Air Ministry Works Directorate engineers technical equipment of the new central area buildings. Of particular interest were the various heating installations which are automatically controlled by "Satchwell" instruments and control panels. A visit was also paid to the company's Frimley works.

Telcon Acquisition

The Telegraph Construction & Maintenance Co., Ltd., has acquired the whole of the undertaking of Magnetic & Electrical Alloys, Ltd., of Burnbank, Hamilton, Scotland. For many years Telcon and M. & E.A. have worked closely together, Telcon supplying nickel-iron alloy strip from which M. & E.A. produce heat-treated laminations, cores and stampings for the electrical industry. M. & E.A. also produce silicon iron laminations, including transformer and motor laminations and core assemblies. The acquisition will make for closer integration of production combined with greater efficiency and economy in Telcon's metals division. M. & E.A. will carry on business as heretofore; Mr. J. Ancel Holden is continuing as chairman, and Mr. W. F. Randall, a director of Telcon, has been appointed vice-chairman and managing director. The other directors are Mr. B. H. Musgrave, a director of Telcon, and Mr. A. A. Asplin, who will continue as works director at Hamilton. Both Mr. Holden and Mr. Asplin were formerly with the Telcon organization at the old Gutta Percha Co.'s factory in North London, and left in 1929 to found the concern now known as Magnetic & Electrical Alloys.

Railway Standard Charges

The Railway & Shipping Publishing Co., Ltd., 12, Cherry Street, Birmingham, 2, has published a completely revised edition of "Class Rates Section of Standard Charges" which covers the 7½ per cent and 15 per cent increases in railway charges which came into operation on 5th June last. The rates shown cover all classes of goods from Classes 1 to 20, and in addition to the station to station rates, the collected and/or delivered rates are shown for classes 11 to 20. Any present day standard rate may be obtained at a glance to any destination up to 730 miles. The 7½ per cent figures are for consignments of 1 ton and over and the 15 per cent figures are for consignments of less than 1 ton. The price of the publication is 20s post free.

Australian Switchgear Tenders

Our Sydney correspondent reports that Mr. R. W. C. Anderson, assistant director of the Australian Associated Chambers of Manufacturers, who recently alleged that United Kingdom manufacturers were quoting uneconomic prices for switchgear, said that Australian authorities in Britain were investigating the rest of a particular contract and also others. If they found that goods had been consistently "dumped," the Minister for Trade and Customs could ask the Tariff Board for a full inquiry. The

Board could impose heavy dumping duties on top of normal duties under the Industries Preservation Act. Mr. Anderson said Australian manufacturers of switchgear had advised the Government about a year ago that some United Kingdom manufacturers were quoting extremely low prices in certain instances. The Australian firms believed these prices were much less than the general domestic prices being quoted in the United Kingdom for similar equipment.

In reply to the allegation the president of the Australian Association of British Manufacturers, Mr. C. W. Goodman, said he could not imagine British manufacturers dumping goods in Australia to beat local manufacturers. They quoted a price at which they were prepared to accept the order.

A.S.E.E. Lecture

In the list of coming events published in our issue of 1st July, the date of the annual joint lecture of the Association of Supervising Electrical Engineers with the Institution of Engineers in Charge was given as 16th November. The A.S.E.E. now informs us that this meeting will be held on Tuesday, 15th November, at the G.E.C., Magnet House, Kingsway, London, W.C.2.

Electrical Engineers Exhibition Competition

It has been decided by the Exhibition Organizing Committee to run a competition for a poster in connection with the fifth A.S.E.E. Electrical Engineers Exhibition to be held at Earls Court. Cash prizes will be awarded to the best three entries by an adjudicating panel. Designs from students and amateurs will be welcomed. Further information can be obtained from the general manager, 23, Bloomsbury Square, London, W.C.1 (telephone: Museum 3450).

Handbook of Hard Metals

A British translation of the major part of the "Handbuch der Hartmetalle," by Dr. W. Dawihl, has been published by H.M. Stationery Office for the Department of Scientific and Industrial Research; price 25s. Three firms shared the task of translation. They were Hard Metal Tools, Ltd., the Metropolitan-Vickers Electrical Co., Ltd., and Murex, Ltd. A certain amount of condensation was necessary, but this was achieved without detracting from the value of the book by removing information already well known or previously published in English. Dr. W. Dawihl is now a reader in metallurgy at the Illingen University, Saar, and is also a leading authority on sintered metal techniques. He was formerly head of the Osram organization for hard metal research.

The Handbook deals with three principal classes of hard metals, viz., sintered alloys of hard carbides to which small amounts of metals have been added; alloys with a tungsten carbide base; and hard facing alloys applied by gas or electric welding to a hard carbide base. The publication opens with a general survey of the subject and of the physical properties of hard metals and their metallography, and it goes on to deal fully with the scientific principles of the sintering techniques as far as they apply to the production of hard metal.

In the section of the book dealing with production the organization of the factory and the works supervision of hard metal production are dealt with and the methods of mixing, milling, sintering and shaping the product are described in detail. The text is supported by diagrams, tables, photographs and photomicrographs.

An appendix consists of the author's comments on an American paper entitled "The role of the binder phase in cemented tungsten carbide-cobalt alloys," by Gurland and Norton, which appeared in the "Journal of Metals," Vol. 4, October, 1952. This has been included in order to bring the book up to date.

Commercial Travellers' Schools

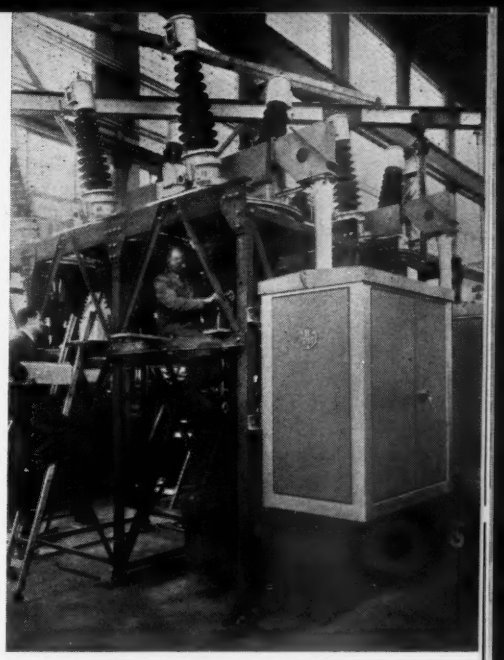
The Court of Governors of the Royal Commercial Travellers' Schools was held on 22nd June at St. Ermins, Caxton Street, S.W.1, when the chair was taken by the president of the Schools, Mr. Leslie Gamage (General Electric Co., Ltd.). Mr. Gamage referred to the considerable adverse balance following upon that of some £7,500 for the previous year and stressed the need for greatly increased support which must be forthcoming to enable those responsible for the administration to do full justice to the needs of the children in the care of the Schools.

Japanese-German Technological Co-operation

Allgemeine Elektrizitäts - Gesellschaft and a Japanese concern, K. K. Meidensha, one of the leading makers of heavy electrical machinery and equipment, have signed a technological assistance agreement, valid for a term of ten years, relating to the manufacture of transformers and air-blast circuit-breakers.

Power Station Plant for Australia

Orders have been received by the British Thomson-Houston Co., Ltd., through the Australian General Electric (Pty.), Ltd., covering turbo-alternators, transformers, and switchgear for the new Wallerawang power station of the Electricity Commission of New South Wales. Four B.T.H. 30 MW single-cylinder turbo-alternators, with "Magnestat" voltage regulators, are at present on order, while the transformers include four 32·5 MVA, 11/132 kV generator units and two 10 MVA, 132/3·3 kV interconnector units, all with on-load tap changing gear. In addition, five 4,000 kVA, 11/3·3 kV and eleven



66 kV, 1,000 MVA Type OW.407 oil circuit-breakers in course of manufacture for the Wallerawang power station of the Electricity Commission of New South Wales

1,000 kVA, 3,300/415 V transformers are being supplied.

The switchgear includes eleven 132 kV, 2,500 MVA oil circuit-breakers, seven of which have already been completed at the company's Willesden works, and ten 66 kV, 1,000 MVA type OW.407 units. Five of the latter units have been built, and manufacture is going ahead on the 3·3 kV Class AL air-break auxiliary switchboards and the control and relay panels for the whole station.

Insulation Factory Fire

Last month a fire occurred at the works of Jones, Stroud & Co., Ltd., Long Eaton, manufacturers of insulating materials, which did considerable damage to the varnishing building and plant. By various means the company was able to keep part of the production going and it is now back in full manufacture.

Netherlands Electrical Manufacture

The Association of Manufacturers of Electrical Equipment in the Netherlands has published recently figures relating to the turnover and export of electrical equipment in 1954. The table below gives these figures for 1939 and the five years 1950 to 1954.

Year	Turnover (mill. guilders)	Exports (mill. guilders)
1939	144	69
1950	670	292
1951	875	413
1952	870	446
1953	914	479
1954	1,080	578

Among the most important groups of products exported last year were radio receivers (valued at fl.292·8 million); lamps and tubes for lighting purposes (fl.73·2 million); household

appliances, excluding vacuum cleaners (fl.47·6 million); switchgear and insulation material, control, distribution and safety equipment (fl.36·4 million); electric motors, generators, convertors, transformers, etc. (fl.35·2 million); wires and cables (fl.35·2 million); telephone and telegraph apparatus (fl.17·4 million); electro-medical instruments, electric meters and measuring apparatus (fl.12·9 million); and vacuum cleaners (fl.12·5 million). (1 fl. equals 1s 11d.)

B.I.C.C. Travelling Scholarship

British Insulated Callender's Cables, Ltd., has instituted a travelling scholarship as a tribute to Sir Alexander Roger, K.C.I.E., for many years chairman of the company and now its first honorary president. It will be known as the Sir Alexander Roger Travelling Scholarship. With a value up to £1,000 in addition to normal emoluments, it will be awarded annually to an employee of B.I.C.C. or of one of the various companies of the group and will enable a young man or woman of ability to travel overseas for study, training and general education for a period of not more than twelve months.

Canadian National Exhibition

The "Modern U.K." stand at the 1955 Canadian National Exhibition, which will be held from 26th August to 10th September, will have 565 exhibits. These have been selected by the Council of Industrial Design from 245 suppliers all over the United Kingdom; their collection for shipment has been made in spite of many difficulties caused by the recent railway strike. The selectors have made special efforts to ensure the suitability of the chosen goods for the needs of the Canadian market. The opinions of London representatives of Canadian buying houses were sought at a preview held in London earlier this year.

The list of goods selected by the Council of Industrial Design for display on the stand includes electric kettles (L. G. Hawkins & Co., Ltd., and Bescol (Electric), Ltd.); radiator (Dimplex, Ltd.); food mixer (Kenwood Manufacturing Co., Ltd.); electric coffee pot (Russell Hobbs, Ltd.); and an electric table lamp (Hiscock, Appleby & Co.).

Advertisement Correction

Ferranti, Ltd., wish to draw attention to an error in the text of No. 5 in a series of announcements featuring the Ferranti FMP prepayment meter which appears on page 77 of this issue. The formula representing the coins in the box is incorrect and should read "price per unit (units used + units unused)."

Television in Northern Ireland

The B.B.C. is to open the permanent medium-power television station at Divis, near Belfast, Northern Ireland, on 21st July. This station will replace the temporary one at Glencairn, near Belfast, which has been in service since May, 1953, and will use the same frequencies (channel I; vision 45 Mc/s, sound 41·5 Mc/s). The transmissions from the new station will be horizontally polarized; existing receiving aerials can therefore continue to be used, but may in some cases need to be re-orientated when Glencairn is replaced by the Divis station.

Annual Holidays

The works of the Banner Electric Co., Ltd., Hoddesdon, will be closed for the annual holiday from 5th to 22nd August.

The Southend-on-Sea works of E. K. Cole, Ltd., will be closed for the annual holiday between 16th July and 1st August inclusive.

Transformers (Watford), Ltd., are closing their works for the annual holiday from 29th July to 16th August.

The factories of Hoover, Ltd., will be closed for two weeks, commencing on the following dates:—Perivale, Middx, and High Wycombe, Bucks, 18th July; Merthyr Tydfil, Glam, 25th July; Cambuslang, Lanarkshire, 29th July.

The works and offices at Luton of the Jackson Electric Stove Co., Ltd., will be closed from 15th July to 2nd August for the summer holidays.

The office and works of William McGeoch & Co., Ltd., Birmingham, will be closed for the annual holiday from 22nd July to 8th August.

Works Visits

Part of the programme of the summer meeting of the Institution of Mechanical Engineers at Southampton included a visit on 7th July to the No. 2 plant of the AC-Delco Division of General Motors, Ltd.; about forty members of the Institution took part. They were received by Mr. C. N. Faulconbridge, general manager, and Mr. D. Bennion-Browne, director i/c Plant No. 2. The tour covered the automatic production of a.c. oil filter elements, and the manufacture of a.c. air cleaners. The party was entertained to lunch at the Potter's Heron Hotel.

Delegates attending the London meetings of the International Electrotechnical Commission recently visited the works of the Hackbridge & Hewittic Electric Co., Ltd. Various stages of the manufacture of glass bulb rectifiers were seen, including the testing of a completed equipment, and a special demonstration of the fabrication of large multi-anode rectifier bulbs was given. The visitors also saw a large number of transformers in capacities up to 120 MVA in various stages of manufacture and the enlarged impulse generator section now in course of erection.

A party of thirty-one delegates to the International Electrotechnical Commission visited the Gravesend works of W. T. Henley's Telegraph Works Co., Ltd., on 6th July, when they were conducted round the cable factory and the engineering works. A visit was also paid to the research laboratories, the party afterwards being taken by coach to the "Leather Bottle," an inn at Cobham, Kent, where they were entertained.

Delegates of the Commission also visited the new metals factory of the Telegraph Construction & Maintenance Co., Ltd., at Manor Royal, Crawley, on 8th July. At a luncheon at the works they were welcomed by Mr. J. N. Dean, chairman of Telcon, and Mr. W. F. Randall, managing director of the recently created Metals Group. After lunch, the delegates toured the factory and laboratories under the guidance of Dr. G. A. V. Sowter, manager of the Metals Division, Dr. H. H. Scholefield and Mr. K. M. Rose. Among those present were Dr. E. W. Smith, Mr. J. Innes, C.B., Mr. W. Glass, directors of Telcon, Col. C. A. C. Turner, C.B.E., T.D., chief executive of the Crawley Development Corporation, Mr. H. F. Wilson, research controller, and Mr. C. L. G. Fairfield, general sales manager of Telcon.

Trade Announcements

In order to correlate the functions of its sales and service personnel in these territories to better advantage, **C.A.V., Ltd.,** announces that the following changes have been made. Mr. J. J. Brown, at 51, Upper Library Street, Belfast, has been made area sales manager, and will in future concentrate on the sale of initial equipment, covering both Eire and Northern Ireland. Mr. R. J. Hale will be responsible for service issues in both territories, as senior service engineer, while Mr. H. Draper will act as service engineer, attached to the Dublin depot.

E. K. Cole, Ltd., has acquired a controlling interest in Dynatron Radio, Ltd. There is no intention of changing the management, personnel or policy of the business, which is concerned with the manufacture and marketing of radio, television and electronic equipment.

Thorn Electrical Industries, Ltd., and **Ekco-Ensign Electric, Ltd.,** announce that there will be no change in their trade discounts in respect of "Atlas" and "Ekco" tungsten filament lamps and fluorescent tubes.

W. & H. Nelson, Ltd., Mossend, Lanarkshire, manufacturers of electrical equipment for mining and industry, have appointed the British Flottman Drill Co., Ltd., Cardiff, as their agents for South Wales. The territory covered by the agency includes the entire South West Division of the National Coal Board.

The address of the Glasgow office of **Burton, Griffiths & Co., Ltd.,** is now 135, Wellington Street, Glasgow, C.2 (telephone: Central 0021/2).

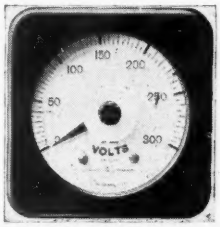
H.V.E. (Electric), Ltd., have moved to larger premises at Viaduct Works, Viaduct Place, Kirkstall Road, Leeds, 4 (telephone: Leeds 29315).

NEW ELECTRICAL EQUIPMENT

Moisture-Proof and Shock-Resisting Instruments

New hermetically-sealed, 4in diameter dial, circular scale, flush mounting switchboard instruments have been developed by CROMPTON PARKINSON, LTD., Aldwych, London, W.C.2, and are the first of their type to be tested and approved by the Ministry of Supply.

These instruments have been developed to meet the need for small compact instruments which have long open scales and are capable of withstanding the treatment imposed by the most severe operating conditions. They are already available as moving-iron and moving-coil ammeters and voltmeters, frequency indicators and wattmeters, and it is understood that their availability as power factor indicators and synchroscopes is imminent.



Crompton hermetically sealed voltmeter

Within a dial diameter of only 4in, a scale of at least 6½in length has been provided and special features have been incorporated enabling the instruments to retain a high degree of accuracy in a temperature range of −40 deg C to 70 deg C under conditions of 95 per cent humidity, to sustain an internal pressure differential of 10 lb/sq in without leakage, and to resist mechanical shocks up to 50 g.

The movement, windings, dials and terminals are all mounted on a shock resisting, nylon-field, moulded plastic base to form a complete unit which is a push fit into a rustproof, heavy-gauge, pressed-steel outer case. All sealing rings are "trapped" in precisely dimensioned grooves and serve, when all air has been evacuated from the instrument and replaced by dry nitrogen, to provide the exceedingly efficient sealing of the complete instrument.

Higher H.P. Brook Motors

For many years a.c. motors up to 250 h.p. have been made by BROOK MOTORS, LTD., Empress Works, Huddersfield, but in view of the demand this range has now been extended to a maximum of 500 h.p. ventilated and 350 h.p. totally enclosed in both cage and slip-ring types and new plant to deal with the machining of larger castings has been added to the equipment in the large motor section of the Huddersfield works. The standard construction of cast-iron yoke and endshields has been maintained but design has enabled the ratings to be produced in extremely compact frames.

The drip-proof design has eight ventilation ports with loose louvres and blanking plates in each endshield; by rotating these through 90 deg, drip proof protection can be obtained in whatever position the motor is mounted. Medium type ball and roller bearings are fitted. These are contained in cartridge housings which enable the rotor to be removed without disturbing the bearings.

Cage rotors are all of the double cage type which limits the starting current to not more than six times full load. Slip-ring rotors are bar wound throughout and have extra large brushes. They are all fitted with short circuiting gear, and can also be supplied for brush lifting.

Transistor Ratings

The maximum permissible collector dissipation of Mullard junction transistors OC70 and OC71 has been raised from 6 mW to 25 mW. The original rating was deliberately made small to ensure adequate margins of safety. The increase reflects the experience gained by the practical application of these new devices. The maximum d.c. collector voltage is 5 V, and the maximum ambient temperature is 45 deg C.

Ceiling Roses

A new range of ceiling roses introduced by NETTLE ACCESSORIES, LTD., Harper Road, Wythenshawe, Manchester, incorporates a flange or break joint ring moulded integrally with the base plate. This dispenses with the need for the usual separate flange ring to cover ceiling marks or plaster irregularities. It is cheaper than purchasing the normal rose and separate ring in the first instance and the makers claim that time is also saved in the fixing.

Nettle ceiling rose

The roses are available with either 2- or 3-plate pillar terminals and are finished in brown or white. Prices per dozen are: 2-plate, brown, 14s 8d; 2-plate, white, 17s 8d; 3-plate, brown, 17s 8d; and 3-plate, white, 20s 8d.

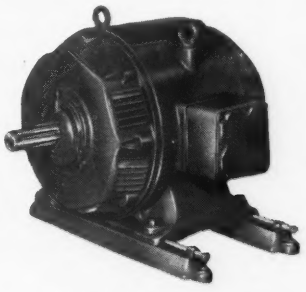
Television Aerials

Four more varieties of band III channel 9 aerials for mounting on the sides of existing band I aerial masts are now available from BELLING & LEE, LTD., Great Cambridge Road, Enfield, Middlesex. These are a 3-element high front-to-back ratio (not high gain) aerial for side mounting on 1½in dia. band I masts, a similar one but for 2in dia. masts, a 6-element high gain and high front-to-back ratio aerial for side mounting on 1½in dia. band I masts and a similar one again for 2in dia. masts. The list price of the first two is 34s and of the second two 50s 6d.

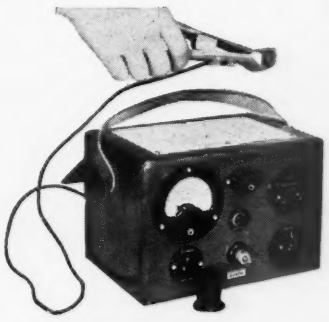
Earth Continuity Tester

The only reliable way of testing the continuity of an earth conductor is to measure its resistance under conditions of heavy current flow. The "Briticent" full-load earth continuity tester has been developed by the BRITISH CENTRAL ELECTRICAL CO., LTD., 6, Rosebery Avenue, London, E.C.1, to carry out this task.

The instrument is housed in a polished wooden cabinet and consists of a double-wound transformer, direct-reading meter calibrated in ohms, gas discharge warning lamp, spring-loaded test button, mains inlet socket and plug, a pair of steel crocodile clips, 15 A three-pin test socket, "zero-setting" transformer tapping switch, and an earth terminal. It is fitted with leather carrying handle, weighs 7¾ lb and is sold at £20 net.



Brook drip-proof cage type motor for up to 500 h.p.



Full-load earth continuity tester

Tasmanian Water Power

Governor-General Opens Tungatinah Scheme

EIGHT years of construction work was brought to fruition in the central highlands of Tasmania recently when the Governor-General of Australia, Sir William Slim, officially inaugurated the Tungatinah hydro-electric scheme by operating a switch which set in motion one of the 35,000 h.p. turbines. A large crowd watched the ceremony, including Members of Parliament. When the fifth turbo-generator set, now being installed, is completed Tungatinah will be the largest hydro-electric power station in Australia.

(Courtesy, "The Mercury," Hobart)

Declaring the station open, Sir William dedicated it "to the benefit of all people who will use the power on farms, in the home, in industry, and every way and to the advantage of Tasmania." The Premier, Mr. Cosgrove, said he wondered how many city workers stopped to think of the men working in the wilds to provide the power for their industries. He referred to Tungatinah as a monument to the Hydro-electric Commissioner, Mr. Knight, those who conceived the project, and to those men who did the ordinary jobs in the mud, snow and rain during the long, hard winters of construction.

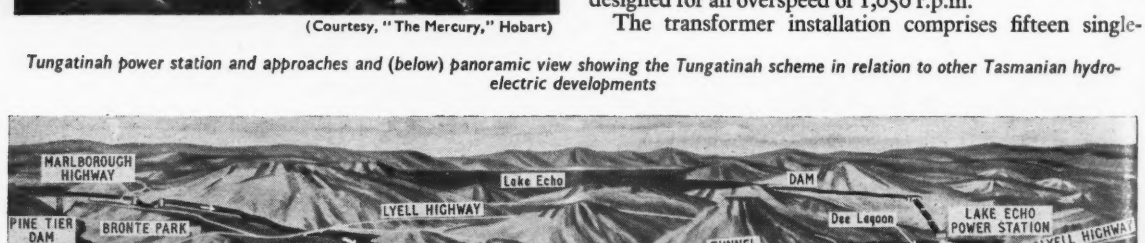
In 1947, when a rapid post-war increase in demand was experienced, the Hydro-Electric Commission of Tasmania recommended the establishment of Tungatinah. The name is derived from the now dead language of the Tasmanian aboriginals and means a shower of rain or a waterfall.

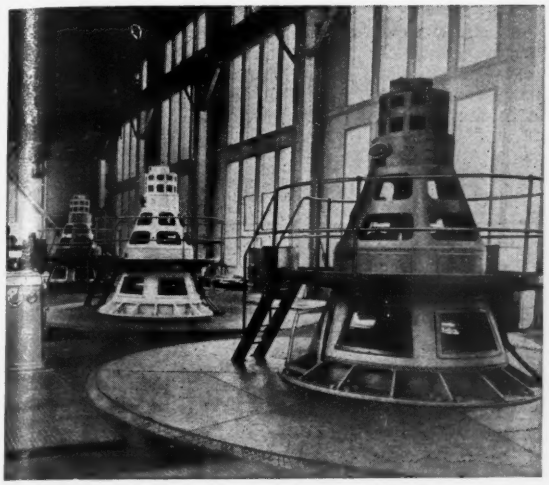
The scheme draws water from three separate catchment areas on the central plateau between the Lake St. Clair-Tarraleah and Great Lake catchments. The principal catchment is drained by the Nive River. Diversion of the Nive River, the first part of the undertaking, was begun only in 1948, and the first power was generated at Tungatinah station on 30th June, 1953. The diversion dam at Pine Tier, on the Nive River, is a concrete gravity dam about 120ft high. The water is carried by a canal system six-and-a-half miles long to Bronte Lagoon.

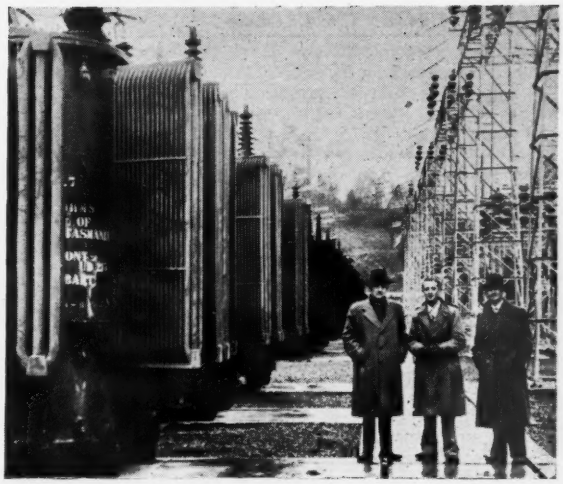
The generating plant consists of five 25,000 kW alternators ordered from the British General Electric Co., Pty., Ltd., Australia, and designed and built at the Witton Engineering Works of the G.E.C. Each alternator is of the vertical shaft type; mounted above, and directly coupled to it, are the main exciter, pilot exciter and permanent magnet governor alternator. The complete machine is driven from below by a directly coupled Francis turbine of Boving manufacture rated at 35,000 h.p. and operating under a static head of 1,005ft, the set being designed for an overspeed of 1,050 r.p.m.

The transformer installation comprises fifteen single-

Tungatinah power station and approaches and (below) panoramic view showing the Tungatinah scheme in relation to other Tasmanian hydro-electric developments







Left: The first three G.E.C. alternators. Right: Mr. A. P. Quarrell, chairman of British Oil Engines (Australasia) Pty., Ltd., and managing director of Brush Electrical (Australia) Pty., Ltd., Mr. Lytton, maintenance fitter, and Mr. Colin Bisdee, Brush sub-agent in Hobart, photographed near the transformers supplied by the Brush Electrical Engineering Co. for the Tungatinah station

phase units of 10 MVA, manufactured by the Brush Electrical Engineering Co., Ltd. They are arranged in five three-phase banks and step up the generating voltage of 11 kV to 110 kV for transmission. Single-phase units were adopted because of the difficulty of transporting three-phase units to a site 2,000ft above sea level and at the bottom of a relatively narrow gorge with very steep approaches. The low voltage sides of the transformers have delta connections with star connections on the high voltage sides. The units are of the standard Brush core type design, oil immersed, and naturally self-cooled.

The Tungatinah development will supply a regular flow of water to the Wayatinah power station, now under construction lower on the Nive and Derwent Rivers. It forms part of a comprehensive scheme to harness the water power resources of the whole of the Derwent catchment area.

The testing of the Trevallyn tunnel on the following day was equally important. Water from the South Esk River surged for the first time through the two-and-a-quarter mile tunnel built for the Trevallyn hydro-electric scheme near Launceston. Generation was expected to start in six or seven days' time. The scheme will be capable of providing 112,000 h.p. but the actual output will depend upon the amount of water available. Most of the power will feed the Bell Bay aluminium project.

Commission's Report

In its report for the year ended 30th June, 1954, the Hydro-Electric Commission says that it has not been able to get sufficient suitable labour to maintain the planned programme of development which is essential if it is to meet the anticipated loads. Last year favourable water conditions enabled the ordinary requirements of residential and commercial consumers to be met in full (although regulations for rationing were in force during the whole of the financial year). Should the rainfall be less than the average, a serious position might again arise. The present programme includes the Lake Echo and Wayatinah power stations. Several alternatives for the utilization of the River Derwent below Wayatinah are being investigated and other proposals being studied concern developments on the King, Franklin, Huon, Murchison, Mackintosh, Mersey and Forth Rivers.

During 1953-54 the Commission sold 709·8 million kWh in bulk to major industries and 486·2 million kWh to retail consumers, these figures comparing with 567·3 million and 434·4 million kWh respectively in the previous year. Retail consumers at 30th June, 1954, numbered 97,450, an increase of 4,343. An additional 4,437 electric cookers and 4,055 hot water services were connected, making totals of 53,552 and 41,167 respectively. There was a net profit on the year of £41,583 (against £144,679). Production and distribution costs per kWh sold were 0·179d as compared with 0·186d in the previous year; interest and exchange charges of 0·232d (0·159d) and other charges of 0·204d (0·205d) brought the total to 0·615d (0·550d). Capital expenditure for the year amounted to £9,983,516 (against £10,830,073).

Registered Contractors

THE annual meeting of the National Register of Electrical Installation Contractors was held on Monday last at the Institution of Electrical Engineers, London, Mr. P. V. Hunter presiding. The report of the Registration Board submitted to the meeting showed that the number on the Register at 31st December last was 871. Sixteen new certificates were issued during the year and there were two reinstatements; twenty-six names were removed from the Register, of which ten were due to resignation or failure to renew registration. The number of inspections carried out was 375, involving examination of 746 installations of all descriptions. The inspection reports received indicate that there is a distinct trend towards closer observance of the I.E.E. Wiring Regulations, and the report states that it is encouraging to learn from inspecting engineers that many manufacturers have considerably improved the design of accessories to permit satisfactory compliance with I.E.E. Wiring Regulation No. 404(J), but some improvement is still possible in such items as bell transformers, earth leakage trips and time switches. The Organizing Committee for the National Inspection Council for Electrical Installation Contracting has announced that the agreement of the sponsoring bodies has now been obtained to the setting-up of a National Inspection Council; the Committee hopes to publish its report in the near future.

Financial Section

STOCKS and SHARES

SIGNS of faltering in the advance of industrial share prices about the beginning of this month were partially met by another wave of buying, which carried many shares to new altitude records. Early this week, some raggedness again became apparent through alarm over the rise in coal prices. The gilt-edged market expects at any time now to see a new issue of British Electricity stock, following upon this week's offer of £100 million Gas 4 per cent stock at 98. Many industrial companies are taking advantage of strong market conditions to raise fresh capital for the financing of expansion plans. A "rights" issue by T.C.M., and advance notice of another from British Oxygen, follow similar operations in recent weeks by Thorn Electrical, Enfield Rolling Mills, Ultra, S. Bird and others.

Atomic Pewor

Once again the shares of companies in what has become to be known as the "atomic power group" have been receiving a lion's share of industrial market activity. Of the electrical equipment issues, A.E.I., G.E.C. and English Electric all added 5s or so to previous big advances, before coming back a little from the top. Babcocks rose further on the strength of the multi-million power plant contract, and for similar reasons there was a big rise in the shares of Head, Wrightson to £6¼. Reyrolles have been dealt in up to 126s, and Parsons at around 95s.

Higher Prices

A rise of about 5s to 78s 6d in British Oxygens followed news of the coming issue, of which the terms have yet to be fixed. Hackbridge Cable spurted 4s, to 21s 3d, and Hackbridge & Hewittic rose further in advance of the proposed scrip and cash issues. On consideration of the full annual report, Richardsons Westgarth were strong, with dealings in the market up to 17s 6d. Hall Telephone put on 2s 9d and other improvements of 3s or more were recorded for Plessey, Murex, Metal Industries and British Aluminium.

G.E.C.

The General Electric Co. is expected to declare the final dividend, together with the preliminary financial results for the year ended last March, on the 21st of this month. The £1 shares have remained strongly supported in anticipation of the event. Now 70s, the shares have risen on balance from about 55s since the "rights" issue of nearly two million new shares in February. These new shares are entitled to participate in the coming payment. At that time, the company was expecting profits for the year to work out at not less than the previous result, and to be able to recommend a final dividend of 8 per cent on the increased capital. This would bring

The Week's Price Changes

Company or Board	Nom. Value	Middle price 11th July	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	84⅛	+1	3	3	3 11 0	94⅜	83⅛
Brit. Elec. 1974/77	100	84⅛	+1	3	3	3 11 0	93⅜	93⅛
Brit. Elec. 1976/79	100	88⅛	+1	3⅛	3⅛	3 19 0	98⅜	87⅛
Brit. Elec. 1974/79	100	100⅛		4¼	4¼	4 4 6	109	99⅛
Overseas Electric Supply								
Calcutta Elec.	£1	21/6		6†	6†	5 11 8†	22/6	20/9
East African Power	£1	23/6	+1/-	7	7	5 19 3	23/6	19/9
Nigerian Elec.	£1	24/6	+1/-	10	10	8 3 3	27/-	22/6
Palestine Elec. "A"	£1	21/-		Nil	Nil	—	22/9	21/-
Perak Hydro-Elec.	£1	21/-	+2/-	6	10	9 10 6	21/-	17/9
Equipment and Manufacturing								
Aberdare Cables	5/-	14/3	−3d	12½	17½	6 2 9	14/6	11/-
Aerialite	1/-	5/9		88⅛	88⅛	—	6/7	5/3
Allen, W. H.	£1	83/9xd		20	20	4 15 6	83/9	77/-
Aron Elec. Ord.	£1	58/9xd		20	15	5 2 3	63/9	55/6
Assoc. Elec. Ord.	£1	90/-	+3/9	11¼	14	3 3	92/6	65/3
Automatic Tel. & El.	£1	78/3	+1/3	15	15	3 16 9	79/6	69/-
Babcock & Wilcox	£1	95/6	+6d	12*	15	3 2 9	98/-	68/6
Baldwin, H. J.	2/-	5/6	+3d	20	20	7 5 6	5/6	4/4
Bakelite	10/-	33/6		12½	16	4 15 6	33/6	27/-
British Aluminium	£1	54/-	+3/6	10	12	4 9 0	54/-	35/3
B.I. Callender's	£1	55/-	+1/6	10	10	3 12 9	55/3	44/9
B.I. Callender's 6% Pref.	£1	23/-	−6d	6	6	5 4 3	26/6	23/-
British Thermostat	5/-	33/9		27½	27½*	4 1 6	33/9	22/6
British Vac. Cleaner	5/-	10/-	+1/-	25	30	—	10/-	7/-
Brook Motors	10/-	45/-		20	20*	—	45/-	39/9
Brush Ord.	5/-	9/3	−3d	6	10	5 8 0	9/6	7/7
Bulgin, A. F.	1/-	8/-		30	45	5 12 6	8/-	4/-
Burco	5/-	18/9		35	25*	6 13 3	23/-	18/9
Chloride El. Storage "A"	£1	77/-	+2/-	12½	17½	4 11 0	77/-	58/6
Clarke Chapman	£1	102/6		20	20*	3 18 1	102/6	68/9
Cole, E. K.	5/-	22/6		27½	17½*	3 17 9	24/9	18/3
Cossor, A. C.	5/-	12/3		10	10	4 1 9	13/-	8/9
Crabtree	10/-	32/6		17½	20	6 3 0	34/6	29/3
Crompton Parkinson Ord.	5/-	18/9	−3d	20	20	—	19/9	16/-
De La Rue	5/-	21/9xd		20	30	6 18 0	26/-	18/9
Decca	4/-	47/6	+3/3	35	56¼*	—	48/9	31/-
Desoutter	5/-	32/6		20	25	3 17 0	32/6	25/6
Dewhurst	2/-	10/-	+3d	19	24	4 16 0	10/-	7/3
Dictograph Tel.	2/-	7/3		20	20	5 10 3	7/6	6/6
Dubilier Condenser	1/-	5/-	−6d	25	25*	5 0 0	5/7	3/10
E.M.I.	10/-	31/-		8	10	3 4 6	37/-	25/3
Electrical Components	5/-	18/9		20	20	5 6 8	18/9	15/3
Elec. Construction	£1	35/9xd		15	8⅓*	4 15 0	41/3	31/6
Enfield Cable Ord.	£1	20/-	−1/-	Nil	Nil	Nil	25/3	20/-
English Electric	£1	80/-	+5/-	10	12½	3 2 6	82/6	54/3
English Electric 3½% Pref.	£1	14/9		3½	3½	5 1 9	16/9	14/9
Ericsson Tel.	5/-	45/-		25†	20†*	2 4 6†	46/6	29/-
Ever Ready	5/-	37/6	+4/-	40	35*	4 18 4	37/6	22/3
Falk Stadelmann	£1	52/6		15	15	5 14 3	52/6	43/9
G.E.C. Ord.	£1	70/-	+5/-	11¼	12½	3 11 6	70/-	51/3
G.E.C. 6½% Pref.	£1	25/-		6½	6½	5 4 0	28/4	23/6
General Cables	5/-	15/-	−9d	30	30	10 0 0	17/-	15/-
Greenwood & Batley	£1	56/9		17½	17½	6 3 3	57/-	54/6
Hackbridge Cable	5/-	21/3	+4/-	20	20	4 14 0	21/3	14/-
Hackbridge & Hewittic	5/-	33/9xd	+1/3	25	30	4 9 0	33/9	23/9
Hall Tel. Acc.	10/-	21/6	+2/9	10	10	4 13 0	22/6	11/-
Heatrae	2/-	5/9	+6d	12½	15	5 4 4	5/9	4/3
Henley's	10/-	21/3	+9d	10½	10½	4 18 9	21/3	17/-
Holophane	5/-	17/6		20	25	7 2 9	19/9	16/-

* After scrip issue. † Free of income tax.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

the total to 12½ per cent, the same rate as before.

T.C. & M. Issue

New £1 ordinary shares issued by Telegraph Construction & Maintenance opened in the market at a premium of around 2s 9d on the price of 32s 6d at which they are offered to shareholders of the company. The issue, totalling the best part of a million shares, was foreshadowed in this year's annual report, which referred to negotiations for the acquisition of a private business, now named as Magnetic & Electrical Alloys. Information is given also of a new interest in a Canadian enterprise. At their all-in price of 35s 3d (free of stamp) the new shares show a prospective yield of rather more than 4¾ per cent, assuming a repetition of the current distribution of 8½ per cent (which includes 1 per cent as bonus) on the larger capital.

in Electrical Investments

Company or Board	Nom. Value	Middle price 11th July	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield % £ s d	1955 Highest	1955 Lowest
Equipment and Manufacturing—continued.								
Hoover	5/-	50/6	+2/-	45	70	6 18 6	52/6	40/-
I.C.I.	£1	56/9	−3d	15	10*	3 10 6	61/9	38/3
Intl. Combustion	5/-	24/-		20	25	—	24/6	16/3
Johnson & Phillips	£1	45/-		15	15	6 13 4	52/6	45/-
Lancashire Dynamo	£1	55/-	+1/3	14	15	—	55/3	37/3
Laurence, Scott	5/-	19/6		20	12½*	3 4 0	19/6	14/6
Lister, R. A.	£1	40/-	+9d	12	9·3*	4 13 0	40/-	30/6
London Elec. Wire	£1	61/3	+1/3	10	12½	4 1 9	61/3	50/6
Lucas, J.	£1	50/-	+6d	10·8	7½*	3 0 0	50/6	41/6
Marryat & Scott	2/-	12/3xd		25	30	4 18 0	13/-	9/6
Mather & Platt	£1	68/6		15	13·4*	3 18 3	68/6	48/-
Metal Industries	£1	37/-	+3/-	12	9	4 17 3	38/-	30/-
Midland Elec. Mfg.	£1	52/6		15	10*	3 16 2	51/3	44/-
Morphy-Richards	4/-	33/9		40	35*	4 3 0	35/-	27/-
Murex	£1	61/-	+3/6	15	15	4 18 3	61/-	49/3
Newman Ind.	2/-	2/9		10	10	7 5 6	3/6	2/4
Oldham & Son	1/-	4/-		17½	20	5 0 0	4/-	2/10
Parnall (Yate)	5/-	11/3	+3d	8	14	6 4 6	13/2	7/3
Parsons, C. A.	£1	92/6	+1/3	7½	10	2 3 3	100/-	56/-
Plessey	10/-	82/6	+3/-	30	20*	2 8 6	82/6	57/6
Pye Deferred	5/-	39/6		20	20*	2 10 9	40/6	28/6
Revo	10/-	15/6		27½	9*	5 16 3	15/6	12/6
Reyrolle	£1	120/-		13½	15	2 10 0	126/-	89/-
Rheostatic	4/-	14/3		20	22½	—	14/3	9/3
Richardsons Westgarth	5/-	17/-	+1/-	15	15*	4 8 3	17/-	11/-
Scottish Cables	4/-	20/-	+6d	27½	27½	5 10 0	22/6	19/3
Smith (England), S.	4/-	19/3	+3d	15	17½	3 12 9	20/-	15/-
Southern Areas	£1	33/-		7½	10	6 1 3	34/9	27/6
Strand Elec.	5/-	10/3		17½	17½	8 10 9	10/3	8/6
Sturtevant	5/-	35/6		18·9	14·4†*	2 0 9†	35/9	21/-
Sun. Elec.	£1	35/-		15	15	8 11 6	35/-	33/9
Switchgear & Cowans	5/-	17/-		10	20	5 17 9	17/-	11/-
Taylor Tunnicliff	5/-	15/9	+1/-	12½	15	4 15 3	15/9	11/3
T.C.C.	10/-	51/3	+2/6	30	25*	4 17 6	51/3	41/-
T.C. & M.	£1	35/-xd		8½	8½	4 17 3	40/9	35/-
Telephone Mfg.	5/-	10/6		10	10	4 15 3	10/6	9/3
Thorn Elec.	5/-	26/3	+1/3	20	15*	2 17 3	33/-	13/9
Thornycroft	£1	45/-	+1/3	15	15	—	45/-	34/6
Tube Investments	£1	95/-		15	17½	3 13 9	98/6	72/6
Vactric	5/-	20/-	+1/3	10	15*	3 15 0	20/-	12/-
Veritys	5/-	9/3		12½	12½	6 15 3	9/3	7/-
Walsall Conduits	4/-	66/3		70	70	4 4 6	66/3	50/-
Ward & Goldstone	5/-	42/-xd		50	30*	3 11 6	45/-	37/6
Watford	2/-	8/9		22½	25	5 14 3	8/9	6/3
Westinghouse Brake	£1	110/-		16	18	3 5 6	110/-	82/-
West, Allen	5/-	16/6		17½	15*	4 11 0	16/6	8/-
Wolf Electric	5/-	21/-	+6d	17½	20	4 15 3	21/-	16/1
Trusts, Transport and Communications								
Anglo-Am Tel.:								
A. Ord.	100	75½		6	6	7 19 0	88	75½
Ord.	100	50		3¾	3¾	7 17 6	54½	50/-
Anglo-Portuguese	£1	25/-		8	8	6 8 0	25/-	21/-
Brit. Elec. Traction:								
Def. Ord.	5/-	23/6	+6d	50	22½*	4 17 9	24/3	19/6
Cable & Wireless:								
Ord.	£1	53/-		9	10	3 15 6	54/-	39/6
4% Loan	100	93½	−2	4	4	4 5 6	100	92
Calcutta Trams	£1	22/6		2½†	6†	5 6 8†	25/-	20/-
Cape Elec. Trams	£1	18/-		5½	7½	8 6 8	18/-	16/6
Marconi Marine	£1	41/3	+1/3	10	10	4 17 0	41/3	33/-
Oriental Tel. Ord.	£1	85/-	+1/3	16	16	—	102/6	96/6
Telephone Props.	£1	98/9	+2/6	—	20	4 0 9	98/9	80/6
Telephone Rentals	5/-	13/6		10	12½	4 12 6	13/6	9/6

Enfield Rolling Mills

Enfield Rolling Mills £1 shares are among the distinguished few to have become more than doubled in value during the course of the present year. Credit for this goes mainly to the successful results for 1954, published in April. A large expansion of earnings enabled the company then to raise the dividend from 10 to a still conservative 20 per cent, covered fully five times by earnings. Now further capital is being raised by an issue of loan stock and an offer of 411,000 new ordinary shares to existing holders at a price of 42s 6d. The premium on these shares is about 35s.

Radio Shares

Good form is again being shown this month by the group still known inadequately as "radio" shares. Optimism has been encouraged by the excellent results announced by Ekco last month. Cossor 5s shares were put up further to 13s, in the market, in anticipation of the announcement of the results before the end of this month. Ever Ready have been active at some 3s to 4s above the official quotation of 34s 6d. Although below the best, Deccas were again higher.

Dubilier Result

Dubilier Condenser Co.'s declaration of a single dividend of 25 per cent for 1954-55 is at the same rate as last year's, but goes to capital increased in the interval by a one-for-four scrip issue. The net profit benefits from lower tax charges, thanks largely to the disappearance of the excess profits levy, so that although the trading profit shows some contraction, the net figure comes out a little higher than before at £113,000.

Motor and Electronics

A final dividend of 10 per cent from Motor & Electronics (formerly Rothermel Corpn.) pay able on capital increased by a one-for-three scrip issue, makes a total for the past year equivalent to 17½ per cent, and to a small increase on the previous payment. Dividends take less than one-third of the net profit of £69,000 (£13,000 up). After an initial reaction, the 1s shares picked up to 4s 6d on consideration of the new capital proposals.

REPORTS and DIVIDENDS

Ferranti, Ltd.—The main figures in the accounts for the year ended 31st March last were given in our issue of 24th June.

In his statement which is circulated with the report and accounts, Sir Vincent de Ferranti (chairman and managing director) refers to the opening by the Duke of Edinburgh of the new laboratory building in Edinburgh in October last. The additional space made available is fully occupied and every aspect of research and development has shown an increase. A significant contribution to increased productivity by the development of computer-controlled machine tools is taking place, and advances which they have made place them in a leading position in this rapidly expanding field. Export orders for aircraft equipment have been maintained at a high level. Further orders for Off-shore Procurement have been received, bringing the total up to $4 million. Production will increase considerably during the forthcoming year. New designs are well advanced in the laboratories at Granton, and it is hoped to introduce them into the Dundee factory in the near future.

While the output of power transformers was lower by 20 per cent than last year, the rate of input has now risen sufficiently to allow the output to be restored to its previous level. Orders for moving coil regulators have doubled and distribution transformer business continues at a satisfactory level. During the year, eighty-seven major units were delivered, including forty for export; amongst the latter were six 230 kV transformers for New Zealand and six for the United States. Several large high-voltage testing equipments are in hand, and a standard range of distribution transformers has been introduced, embodying modern developments in grain-oriented steel cores. The output of insulation tubes and cylinders continues to rise, and the downward trend in selling prices has been reversed. In response to demands for insulation capable of withstanding higher temperatures, a new type of silicone-impregnated glass-cloth cylinder is now being produced. Electricity meter business has continued steady throughout the year. A steady gain in interest in spheroidal graphite cast-iron is assisting an upward trend in the sales output of the foundry. The demand for non-magnetic cast-irons remains steady, but shortage of nickel, an essential constituent, has prevented any increase in output. Some castings are now being produced by the shell-moulding process, which shows signs of effecting considerable economies. The output of Government products remains steady, and further long-term development work has been undertaken in connection with guided missiles.

Additional orders have been received for electronic digital computers. An arrangement has been made with Powers-Samas Accounting Machines, Ltd., whereby the two research and development teams collaborate in the development of a complete range of data-handling equipment for scientific and commercial use. Additional space and the introduction of automatic processing and handling equipment for the production of radio and television receivers should assist in meeting still further increased demands during the latter part of 1955. Development is being actively pursued on systems of colour television, and on semi-conductor devices, and a range of high-quality silicon diodes is now being produced. A considerable expansion in manufacturing facilities for cathode ray tubes was planned during 1954, and will come into operation during the coming year.

Output of instruments has been increased during the year. Amongst the interesting instruments supplied were special metering equipments for the remote indication of power-flow at key points in the national grid system. The range of metering equipments has been completely modernized; electronic test sets are in use by the London Electricity Board, and several sets have been supplied to New Zealand. Their small instruments have been adapted to meet American specifications, and are now being used in equipments ordered under the American Off-shore Procurement Programme. Sales of radiant electric fires have been more than doubled, helped by the introduction of a range of lightweight high-quality fires.

The Hackbridge & Hewittic Electric Co., Ltd.—The results for the year ended 31st March last were published in our issue of 1st July.

In reviewing the year's activities, Mr. A. M. Browne (chairman and managing director) says that the increase in the trading surplus reflects the effect of the measures taken to improve designs and means of manufacture referred to in the last report. Extensions to the factory and offices have been completed, but further process and test equipment and extensions to the factory are required in order to meet changes in techniques which have come about in the products manufactured. Accordingly it is proposed to issue a further 200,000 ordinary shares to finance the extensions now required.

The transformer division achieved its greatest output in large transformers. Among the installations supplied by the rectifier division were a further nine substations for the British Railways, Southern Region. Work for the C.E.A. and Area Boards and for the British Railways and London Transport Executive continues to be the principal outlet at home for the transformer and rectifier divisions respectively. Overseas orders are now increasingly difficult to obtain; keen competition, particularly from Continental manufacturers, in overseas markets is affecting the industry considerably, and this, in turn, makes conditions in the home market more difficult. Nevertheless orders have been obtained at a sufficient rate to ensure full output in all divisions during the coming year.

Ruston & Hornsby, Ltd.—The accounts for 1954-55 were abstracted in our issue of 24th June.

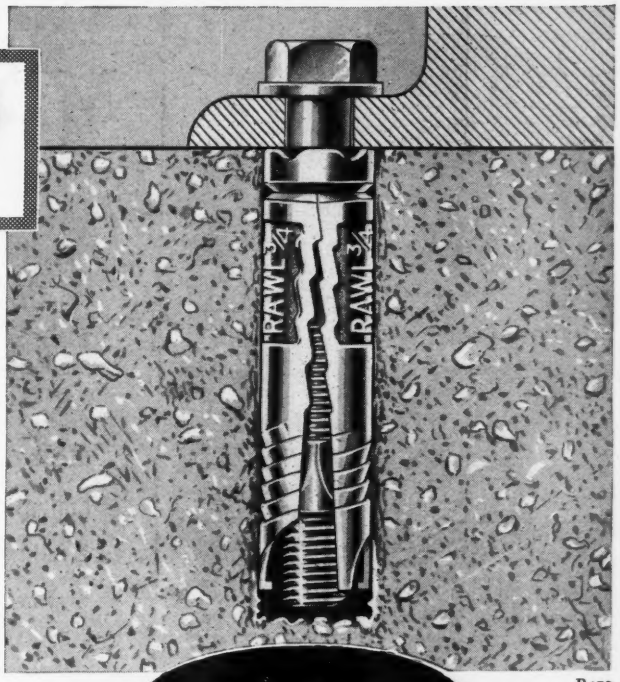
After referring to the proposal to capitalize £2,050,000 of reserves and to issue one new ordinary share for every £2 of ordinary stock held, Mr. W. J. Ruston (chairman) reviews the progress made during the year. Turnover showed an increase of 10 per cent, but part of the increase was due to deliveries on account of the rearmament programme and it is unlikely that this turnover will be repeated on the same scale in the current year. Mr. Ruston refers to the company's activities overseas and mentions that with the growth of secondary industries, particularly amongst the Commonwealth nations, there was an increasing demand made upon them by foreign Governments and others to share in the local manufacture of their products, or requests to grant manufacturing licences.

During the past year they have successfully launched a new range of small diesel engines and a further range will shortly be in production. Several sizes of new diesel locomotives have been developed and put on the market during the past year, including a 45-ton diesel shunter. Production of gas turbines has considerably increased and a gratifying volume of orders has been received from various parts of the world. The boiler works continues to operate at maximum capacity and there is an increasing demand for the company's large vertical engines.

The Telephone Manufacturing Co., Ltd.—The annual meeting was held on 11th July, Mr. F. T. Jackson (chairman and managing director) presiding. In his circulated statement, Mr. Jackson said that activity in all branches of the business during the year under review was maintained at a high level, particularly in the cases of line transmission and marine equipment, capacitors, polarized relays and subscribers' apparatus. Export business continued at the rate of 20 per cent of the turnover with incoming orders at a slightly higher rate, although in many cases the prices were unremunerative as a result of intense competition. The Carrington Manufacturing Co. shared in the prosperous conditions in the radio industry. The supply of apparatus to the British Post Office had been at a somewhat higher

(*Continued on page* 143)

RAWLBOLTS are a Dry Fixing



With Rawlbolts there is no grouting, no waiting for cement to dry before the equipment can be used. This is an enormous time-saving factor in these days of man-power shortage. The solid sides of a small hole, into which a Rawlbolt fits snugly, afford all the resistance required for the expanding metal shields as the bolt is being tightened. When fully expanded, the metal shields exert a tremendous grip on the sides of the hole, ensuring an absolutely firm fixing. Rawlbolts are made in all sizes from $\frac{3}{16}$" to 1" bolt diameter, Whitworth thread. There are two types, Bolt-projecting and Loose-bolt (as illustrated), which is specially useful for heavy equipment because bolts can be inserted after the fixture has been placed in position.

RAWLBOLT **REFERENCE CHART FREE**

Size 20" x 28½" this chart illustrates the 29 Loose Bolt and 21 Bolt Projecting Rawlbolts in their actual sizes. Different types of hole boring tools are also shown. Ask for a copy.

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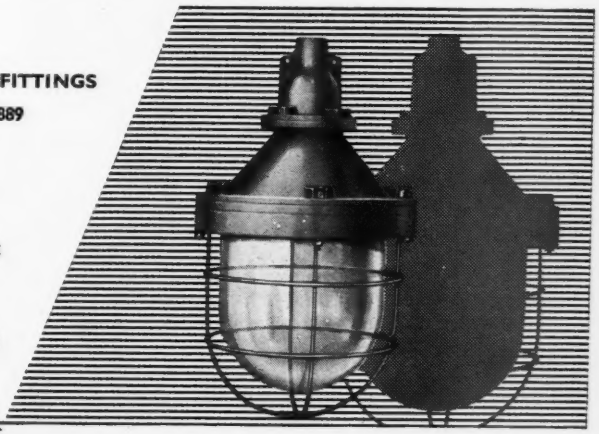
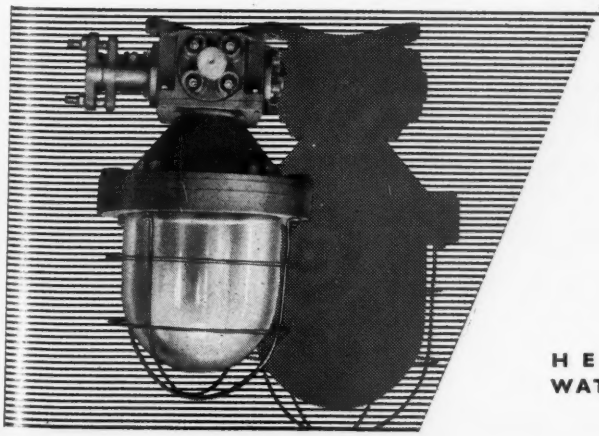
THE WORLD-WIDE FIXING DEVICES ORGANISATION

Flameproof WELL GLASS FITTINGS TO BS.889



We have designs to suit every lighting need and welcome your enquiries.

Designed in accordance with B.S.889-1947 these ceiling mounting or pendant pattern flameproof lighting fittings are safe, strong and efficient. They are manufactured in four sizes—60, 100, 200 and 300 watt. The ceiling type joint box may be fitted with up to 4 cable sealing glands, conduit plates, or blanking plates, whilst the pendant pattern is tapped for conduit. Supplied in cast aluminium or cast iron and finished in green enamel. Certified by the Ministry of Fuel and Power.



FLP *London Office: 11 John Street, W.C.1*

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WATER HEYES ELECTRICAL WORKS, WIGAN

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Transva kVA Demand Meter (with or without alarm contact).

Types MASA and MASI Relays. For the limitation of kVA demand.

MODERN TARIFFS require modern methods of LOAD CONTROL

Metrovick equipment for power-factor control and M.D. limitation has been designed by specialist engineers and is fully up-to-date. It can make possible substantial savings in your electricity account.

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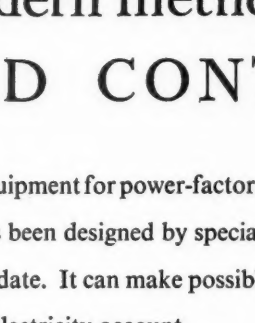

Type NJO4 Relay for the Automatic Control of the Single-stage Capacitors used for power-factor improvement.

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ELECTRICAL CO LTD · TRAFFORD PARK · MANCHESTER, 17

Member of the AEI group of companies

Leading Electrical Progress

G/A 409

Reports and Dividends (*continued*)

level during the year. With regard to the current year, they had a full order book although a portion was at unremunerative prices.

The Electric Construction Co., Ltd.—The financial results for the year to 31st March last were given in our issue of 1st July.

In his review of the year, Mr. C. Reid (chairman) says that the company has again achieved an all-time record in sales, and although the orders in hand are satisfactory, they are slightly less than last year. Tyseley Foundry, Ltd., has continued to trade at a profit though below the previous year's result due to difficult trading conditions in the early part of the year, but is now working at full capacity. The Vereeniging factory of E.C.C. South Africa (Pty.), Ltd., is now in production and has found a ready sale for its products. The sales of E.C.C. Canada have been disappointing during the past year, but they are continuing their efforts to enter this market effectively. The development of business abroad will involve a certain amount of additional capital expenditure, which, however, is included in the total of their capital commitments.

Marryat & Scott Holdings, Ltd.—The group profit for the year to 31st March last is £148,313, as compared with £126,027 for the preceding year, and after deducting £72,235 for taxation, the net balance is £76,078, to which is added £88,247 brought in, making £164,325. It is proposed to pay an ordinary dividend for the year of 30 per cent (against 25 per cent), and to carry forward £140,275.

In his statement, Mr. M. D. Scott (chairman and managing director) says that the improvement in the profit is partly due to the completion of some large contracts. All the companies at home and the agents and branches overseas have had a busy year. The favourable trend has been maintained during the current year and the volume of work in hand both in numbers of machines and in value of contracts is once again a record figure representing sufficient to keep production capacity fully employed for at least twelve months.

Warne, Wright & Rowland, Ltd.—In his statement to shareholders, which accompanies the report and accounts for 1954, Air Commodore J. A. Cecil-Wright (chairman and joint managing director) says that the poor results for 1954 were mainly due to the loss of £95,675 made by W. T. French & Son, Ltd., a member of the group. Estimated gross profit margins and calculated stocks were over-stated, as also were the programmed quantities of the new range of electrical products. After investigation it was decided to discontinue the assembly and marketing of complete electrical products and to write off the heavy loss from development. Much of the rearranged factory space has fallen into immediate use for expanding the horticultural export trade, the original business. Early this year an agreement was concluded with Bescol (Electric), Ltd., for that company to take over the assembly and marketing of electrical products under the name of "Mysto."

The Dubilier Condenser Co. (1925), Ltd.—The trading profit for the year ended 31st March last is £265,357, as compared with £353,000 for the preceding year, and after charging £96,707 for taxation, the net profit is £112,967 (against £110,429). It is proposed to maintain the dividend for the year at 25 per cent on capital increased by a one-for-four scrip issue last year. The balance carried forward is £124,187 (against £122,950 brought in).

Radio Rentals, Ltd.—Underwriting is being arranged for the issue of 300,000 additional ordinary shares of 5s each at the price of 30s per share. 249,375 of the new shares are to be provisionally allotted to ordinary shareholders in the proportion of one new share for every six held. Ordinary shareholders will be given the opportunity of applying for shares which are not provisionally allotted or which are not taken up under provisional allotment letters.

The Renold Chain Co., Ltd.—The group profits for the year to 3rd April last amount to £1,137,647, an increase of £476,768 as compared with the preceding year. After providing £538,415 for taxation, the net balance attributable to the parent company is £599,232 (against £305,190). Reserves receive £359,000, and it is proposed to pay a final ordinary dividend of 9½ per cent, making 12½ per cent for the year (against 11 per cent). The balance carried forward is £287,899 (against £228,656 brought in).

The Motor & Electronics Corporation, Ltd.—The accounts for 1954 show a group trading profit of £186,166, as compared with £156,248 for 1953. After meeting all charges, including £67,710 for taxation, the net balance is £68,959, of which £52,285 is dealt with in the accounts of the parent company. It is proposed to pay a final ordinary dividend of 10 per cent (payable on capital increased by a 33⅓ per cent scrip issue), making 20 per cent for the year. The distribution for 1953 was 22½ per cent, which included a bonus of 2½ per cent. The balance carried forward is £170,515 (against £155,685 brought in).

In his statement Sir Reginald R. Whitty (chairman) says that the order book is the largest in the history of the business and the turnover for the current year promises again to be 10 per cent higher than last year's record. The works are already producing to capacity and at the present moment an extension to the premises at Huyton is under consideration; this should provide ample room to the electronic and vacuum divisions, both of which are enlarging their scope of operations.

With the report and accounts proposals are circularized for further capitalization of reserves and the provision of additional working capital. Ordinary stockholders will be allotted, credited as fully paid, 968,583 ordinary shares of 1s each in the proportion of one new ordinary share for every four ordinary stock units held. Holders of the 125,000 4½ per cent £1 redeemable cumulative preference shares are being given the right to subscribe for one unit consisting of one new 5 per cent preference £1 share and one 1s ordinary share at 21s per unit for each preference share held. The new preference shares will rank *pari passu* with the existing preference shares the dividend on which will be increased to 5 per cent. A further 32,084 ordinary shares are to be sold in the market for cash.

The Telegraph Construction & Maintenance Co., Ltd., has decided to issue 977,046 ordinary shares in the existing share capital at a price of 32s 6d per share and to offer such shares for subscription to the holders of the existing issued ordinary shares in the proportion of one new share for each two shares held. The remaining 68,862 shares in the existing ordinary share capital are being reserved for offer at a later date to the employees of the company under a scheme which is in course of preparation.

Hick, Hargreaves & Co., Ltd.—A preliminary statement for the year ended 31st March last shows group net profits, after charging £265,054 for taxation, of £259,706, as compared with £208,107 for the preceding year. It is proposed to pay a final dividend of 15 per cent, and a bonus of 5 per cent, making a total distribution for the year of 25 per cent. This compares with 20 per cent for 1953-54, when the interim dividend of 5 per cent was paid before the 50 per cent free scrip issue.

Newman & Watson, Ltd.—The group profit for the year to 31st March last is £95,126, as compared with £89,723 for 1953-54, and after providing £45,131 for taxation, the net balance is £49,995 (against £41,418). It is proposed to pay a dividend for the year of 30 per cent (against 20 per cent), and in addition to distribute 2½ per cent, not subject to income tax (unchanged).

The directors propose to make a 100 per cent scrip issue, which calls for 850,000 ordinary shares of 2s, and 1·4 million ordinary shares are to be created.

The East African Power & Lighting Co., Ltd.—The accounts for 1954 show that after providing £456,844 for depreciation, the group profit is £546,437, as compared with £438,279 for 1953. Taxation absorbed £54,439 and the ordinary dividend for the year is maintained at 7 per cent by a final

distribution of 4 per cent. The balance carried forward is £179,858 (against £159,088 brought in).

Belliss & Morcom, Ltd., report a group net profit for the year to 31st March last, after deducting taxation of £124,164, of £152,280, as compared with £61,170 for 1953-54, of which £138,674 is attributable to the parent company. Reserve receives £100,000 and it is proposed to pay a final dividend of 8½ per cent, again making 11 per cent for the year, plus a distribution of 5 per cent, not taxable, from capital profits.

Oldham & Son, Ltd.—A preliminary statement shows group profits for the year to 31st March last of £452,958, as compared with £350,967 for 1953-54. Taxation absorbs £222,834 and a sum of £88,291 is placed to general reserve. It is proposed to pay a final dividend of 12½ per cent (against 10 per cent), making 20 per cent for the year (17½ per cent).

Increases of Capital

English Electric Co., Ltd.—Increased by £10,000,000, in £1 ordinary shares, beyond the registered capital of £15,000,000.

Morganite Resistors, Ltd.—Increased by £300,000, in £1 ordinary shares, beyond the registered capital of £200,000. At 16th February, 1955, the Morgan Crucible Co., Ltd., held a majority of the issued shares.

Rowland's Electrical Accessories, Ltd.—Increased by £45,000, in £1 ordinary shares, beyond the registered capital of £5,000.

Ernest Wood, Ltd.—Increased by £1,500, in £1 ordinary shares, beyond the registered capital of £1,500.

Bankruptcies

D. G. H. Hammerton and **A. J. Cummings,** trading at 28, West Street, Warwick, as A.C.D. Electric Co., electrical engineers.—First and final dividend of 7d in the £, payable on and after 28th July at the Official Receiver's office, Somerset House, 37, Temple Street, Birmingham, 2.

P. Logan, 65, Alexandra Road, Heeley, Sheffield, electrical contractor. —Receiving order made 29th June on debtor's own petition. Public examination 11th August at the County Court Hall, Bank Street, Sheffield.

E. H. Tansey, residing and lately carrying on business at 53, Hollydale Road, Erdington, Birmingham, 24, electrical contractor.—Trustee, Mr. R. K. Clark, Somerset House, 37, Temple Street, Birmingham, 2, Official Receiver, released 28th June.

L. C. Shearley, 392, New Cross Road, London, S.E.14, electrician, lately carrying on business at Manor Barn, Aldingbourne, Chichester.—Receiving order made 29th June on a creditor's petition.

F. W. J. Meyer, 4, Dunsany Road, West Kensington, London, W.14, electrician.—Receiving order made 29th June on a creditor's petition.

Liquidation

The Midland Wireless & Electrical Appliance Co., Ltd. (in voluntary liquidation).—Meetings 27th July at the offices of Leeds Barlow & Co., 66, Alma Street, Luton, to receive an account of the winding-up by the liquidator, Mr. H. L. Barlow.

Exhibits for Indian Industries Fair

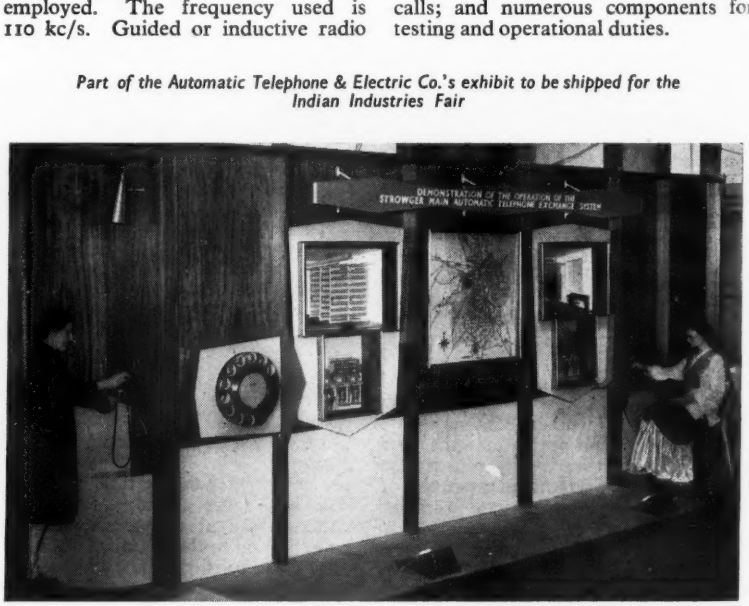
Telecommunication equipment comprising the wide range of products of the Automatic Telephone & Electric Co., Ltd., and its associate companies, will be shown at the first Indian Industries Fair which opens in New Delhi on 29th October. There was a pre-view of the exhibits at the Strowger works, Liverpool, on 7th July, before their dispatch to Glasgow whence they will be shipped later in the month in the *Cilicia.* Executives and engineers of the company will be flown to India to supervise the assembly and presentation of the exhibits, which will occupy an area of about 4,000 sq ft.

One of the main exhibits is a demonstration model of a large automatic telephone exchange, similar to the one sent for exhibition purposes to South America a year ago, but incorporating certain improvements. Models or robots go through all the normal motions of making a telephone call and the progress of the complicated switching mechanism is shown by lights on the exchange instruments until the robots carry on a conversation. Explanations and the conversation are tape recorded, one version being in English and the other in Hindu.

A new development sponsored by A.T. & E. is a transmitter/receiver unit suitable for operation in mines. Weighing only 6 lb and measuring 5in by 6in by 2in, it has been designed to be slung easily from a miner's belt. When used as a portable set a flexible loop aerial resting on the shoulders of the miner is normally employed. The aerial need not be in direct contact with the conductive path being utilized. Using guided or inductive radio it has been found that reception is excellent over considerable distances, no matter how winding the path, by simply utilizing existing cables or rails as a conductor medium. Satisfactory tests have been made in mines over distances of two miles. To transmit a calling signal it is only necessary to press a button on top of the set. The normal telephone handset fitted with a speak/listen switch is employed. The frequency used is 110 kc/s. Guided or inductive radio which takes advantage of any existing metallic conductor paths to carry the transmitted signal has been developed by engineers of British Telecommunications Research and A.T. & E.

Other Delhi exhibits will comprise multi-channel telephone equipment, 12 channel, 60 channel and coaxial; v.h.f. systems including the recently introduced country set which can be operated by a 12 V car battery; mobile v.h.f. sets; a device to provide the automatic trunk routing of telephone calls; and numerous components for testing and operational duties.

Part of the Automatic Telephone & Electric Co.'s exhibit to be shipped for the Indian Industries Fair



CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Ashbourne.—30th July. U.D.C. Two sets of automatically controlled sewage pumps, complete with motors, starters, etc. D. Powell, surveyor, Council Offices.

Australia.—29th July. Brisbane City Council. Three 5,000 kVA and five 500 kVA transformers for Tennyson power station. (E.S.B. 14649/55. Ten/14545.)* 5th August. Bare and insulated copper cables. (E.S.B. 14650/55. Ten/14546.)*

1st September. Western Australian Government Tender Board. 4,000 kVA transformer for Collie power station and three 5,000 kVA transformers for Picton Junction substation. (E.S.B. 14174-5/55. Ten/14152-3.)*

22nd September. State Electricity Commission of Western Australia. Power and control cabling for the Bunbury generating station. (E.S.B. 14176/55. Ten/14490.)*

Belfast.—25th July. Northern Ireland Hospitals Authority. Electrical installation in new ward block at the Royal Victoria Hospital. William J. Ogle, consulting engineer, 63, Main Street, Bangor, Co. Down.

Brighouse.—28th July. Borough Council. Street lighting equipment. (See this issue.)

Edinburgh.—North of Scotland Hydro-Electric Board. 33 kV lines for Kintore substation. (See this issue.)

Formosa.—2nd August. Central Trust of China, U.S.A. Division, Taipei. Cables, wires, lamps, etc. (E.S.B. 13844/55. Ten/14497.)*

Heston and Isleworth.—6th August. Borough Council. Two electrically driven waste paper baling presses. Borough surveyor, 88, Lampton Road, Hounslow.

Ilford.—26th July. Borough Council. Street lighting equipment. (See this issue.)

India.—29th July. Director General of Supplies and Disposals, New Delhi. 12,505 radio receivers, loudspeaker units and aerial kits. (E.S.B. 14288/55. Ten/14479.)* Armoured telephone cable. (E.S.B. 14286/55. Ten/14484.)* 20th September. Power transformers, oil circuit-breakers, switches and insulators. (E.S.B. 14287/55. Ten/14485.)*

1st August. Commissioners for Port of Calcutta. Electrical equipment for Kidderpore Docks, including transformer, switchgear, cables, etc. (E.S.B. 13489/55. Ten/14460.)*

1st August. Calcutta Electrification Project, Eastern Railway, 33 kV transmission lines. (E.S.B. 14405/55. Ten/14517.)*

Islington.—1st October. Borough Council Rewiring of public baths. (See this issue.)

Pakistan.—22nd July. Government Posts and Telegraph Department. V.h.f. testing equipment. (E.S.B. 14016/55. Ten/14459.)*

Prestwich.—27th July. Borough Corporation. Street lighting equipment. (See this issue.)

St. Albans.—8th August. City Corporation. Street lighting equipment. (See this issue.)

South Africa.—28th July. Union Tender and Supplies Board. Stationary electrical dynamometer. (E.S.B. 14441/55. Ten/14505.)* Electronic valves. (E.S.B. 14473/55. Ten/14518.)*

3rd August. Stores Department, South African Railways. Three portable high resistance ammeter-voltmeters. (E.S.B. 14152/55. Ten/14464.)* 250 and 650 V cable. (E.S.B. 14246/55. Ten/14482.)*

Swansea.—Borough Council. Electrical installation in technical college workshop to be erected at Mount Pleasant. Borough architect, Guildhall.

Turkey.—5th October. Iller Bank, Ankara. Hydro-electric plant including a 2,625 kVA generating set and 66 kV overhead line. (E.S.B. 14264/55. Ten/14514.)*

Uxbridge.—22nd August. Borough Council. Electrical installations in greenhouses. Borough surveyor, 263, High Street.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769)

ORDERS PLACED

Ashton-under-Lyne.—Manchester Regional Hospital Board. Recommended. Renewal of electrical installations (phase one) in the General Hospital (£10,785).—S. Dickinson.

Bexley. — Corporation. Recommended. Street lighting equipment for Arbuthnot, Westwood and Hook Lanes, and for Glenmore and Halcot No. 3 housing estate (£3,513).—Concrete Utilities.

Durham.—County Education Committee. Electrical installations in schools:—Medomsley Edge County (£1,265).—Armstrong & Ryan. Felling Wardley Infants' New County (£1,216).—A. F. Jemison. Framwellgate Moor Junior New County (£1,667).—R. V. Hogg & Co. South Stanley Tyne Road New County Infants' (£1,366).—T. Mitchelson.

Longbenton.—U.D.C. Sodium lighting in Benton Lane.—Revo Electric Co.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Birmingham.—Multi-storey factory, Cheapside and Bradford Street; Intermit, Ltd., 37, Bradford Street.

Blackpool.—Twin operating theatres, Victoria Hospital; Manchester Regional Hospital Board, Cheetwood Road, Manchester, 8.

Bolton.—Houses (120), Lever Edge Lane; housing director, Town Hall.

Brighton.—Houses (118), on Sections 10 and 12 of the Woodingdean estate; borough surveyor, 26-30, King's Road.

Bristol.—Baptist church, Cairns Road, Redland; Eustace Button, architect, 23, Berkeley Square.

Bromley.—Technical school for boys; borough engineer.

Castle Ward (Northumberland). — St. Aidan's Church (£14,000); J. T. Bell and Sons, contractors, Northumberland Place, Newcastle-on-Tyne.

Croydon.—Factory, New Addington estate; Kraft Food Products, Ltd., Silverdale Road, Hayes, Middx.

Food warehouse, King Henry's Drive, Addington; Danish Bacon Co., Ltd., 9-13, Cowcross Street, London, E.C.1.

Darlington.—Houses (70); J. D. Collins, R.D.C. surveyor.

Faversham.—Offices, East Street; Whiting & Hine, Ltd., 62, Ospringe Street.

Flintshire.—Secondary modern school at Penley, and primary school at Sandicroft; county architect, County Buildings, Mold.

Gillingham (Kent).—Houses (100), on the Twydall estate; Frank Hill, town clerk, Municipal Buildings.

Glasgow.—Houses (431), Castlemilk, for T.C.; Architect's Department, 20, Trongate.

Gosport.—Houses (144); John Hunt, Ltd., South Wharf, Cleveland Road.

Houses (204), Rowner estate; Hawkings Bros., Ltd., builders, Westfield Road.

Hastings.—Central fire station (£72,000): borough surveyor, Wellington Square.

Hebburn.—Houses (120) at Monkton (£153,000); U.D.C. surveyor.

R.C. school; Robt. Burke, 10, Lambton Road, Newcastle-on-Tyne.

Hereford.—Omnibus garage, Friar Street; Birmingham and Midland Red Omnibus Co., Ltd., Bearwood, Smethwick.

Hetton (Co. Durham).—Community hall and health centre (£10,000); county architect, Court Lane, Durham.

Highworth.—Houses (101), on site at Wroughton; Edwin H. Bradley & Sons, Ltd., building contractors, Okus Quarries, Swindon.

Huddersfield.—Three-storey block of shops and maisonnettes on the Dalton estate; borough architect, High Street Buildings.

Kempston.—Occupation centre; county architect, Shire Hall, Bedford.

Kidlington.—Infants' school for Oxon E.C.; county architect, Park End Street Offices, Oxford.

Lancashire.—Secondary schools at Eccles (£141,520), Bamber Bridge (£134,109) and Kirkham (£138,142), county school at Westvale, Kirkby (£127,343), Carr Head School at Poulton-le-Fylde (£48,648), and extensions, etc., to Manchester Road Secondary School, Leigh (£51,639); G. Noel Hill, county architect, County Offices, Fishergate Hill, Preston.

London.—Dwellings (136), Rectory Road, Hackney; borough housing architect.

Shops and flats, Edgware Road, Paddington; Frank Batty & Smith, Ltd., 18, Spring Street, W.2.

Office block, Willesden; Arthur Berton, Ltd., New River Mills, Brentfield Road, N.W.10.

Large additions to the Thames Sugar Refinery, Silvertown (£200,000); Tate & Lyle, Ltd., 21, Mincing Lane, E.C.3.

Manchester.—R.C. church at Amos Avenue, Newton Heath; Greenhalgh & Williams, architects, 15, Mawdsley Street, Bolton.

Middlesbrough.—Methodist church, on the Whinney Banks estate; G. P. Stainsby, architect, 57, High Street, Stockton-on-Tees.

Morden.—Crematorium; Oscar Faber & Partners, consulting engineers, 29, Queen Anne Street, London, W.1.

Morpeth.—Church at Stobhill (£8,000); W. Leech, Ltd., Clayton Street, Newcastle-on-Tyne.

Newcastle-on-Tyne.—Flats (33), Hill Street clearance area; city architect, 18, Cloth Market.

Laboratory, store and offices, Glasshouse Street, Limmer & Trinidad Lake Asphalt Co.; Mauchlan, Weightman & Elphick, 12, Saville Row.

Block of shops, Northumberland Street, Barratts, Ltd.; and cold storage factory, Beech Street, Sungold Products, Ltd.; Marshall & Tweedy, Grainger House, Blackett Street.

Newcastle-under-Lyme. — Departmental store, King Street; Swettenhams, Ltd., London Road, Chesterton.

North Shields.—Health centre, Spring Terrace; borough surveyor, 16, Northumberland Square, North Shields.

Northumberland.—School at Byrness; county architect, County Hall, Newcastle-on-Tyne.

Oxford.—Flats (54), Wood Farm estate and Minchery Farm estate; borough architect.

Oswestry.—Secondary modern boys' school, Beechfield site (£150,000); R. Sheppard, architect, 15, Bedford Place, London, W.C.1.

Penrith.—Houses (100), Milner Road, Scaws estate, for U.D.C.; Thos. Armstrong, Ltd., South Street, Cockermouth.

Peterlee (Co. Durham).—Houses (136), Dene House, for Peterlee Development Corporation, Shotton Hall, Castle Eden; W. J. Scott, chief architect.

Reading.—Factory, Commercial Road estate; Rudic Products, 15a, Church Road, Caversham.

St. Helens.—Large extensions to premises in Baldwin Street (£400,000); St. Helens Industrial Co-operative Society, Ltd., Baldwin Street.

Southampton.—Police hostel at 12-18, Hulse Road (£86,500); borough engineer, Civic Centre.

Southwell (Notts).—Further instalment of Edward Cludd Secondary School (£46,385); county architect, County Hall, Trent Bridge, Nottingham.

Stockport.—Extensions to Stockport School, Mile End; Schools Architect's Department.

Stockton-on-Tees.—Houses and flats (116), on the Newtown site; Tarslag, Ltd., builders, Bowesfield Lane.

Sunderland.—Old persons' hostel at Pennywell; borough architect, Grange House, Stockton Road.

Swansea.—Houses (99), Llwyn Derw site; R. Hudson, borough surveyor, Guildhall.

Torpoint.—Block of shops with maisonnettes, Queen's Park estate; U.D.C. surveyor, Council Offices, York Road.

Tweedmouth.—County secondary school; county architect, County Hall, Newcastle-on-Tyne.

Twickenham.—Works extensions; A.M.D. Engineering Co., Ltd., Beaufort Road.

Tynemouth.—Three police section stations for the T.C.; borough engineer, 16, Northumberland Square, North Shields.

Walsall.—Houses (106), on Mossley estate (Contracts 4-6); M. E. Habershon, borough surveyor, The Council House.

West Bromwich.—Factory building at Bratt Street, for Kendrick & Jefferson, Ltd.; Simms & Gifford, architects, 323, High Street.

Wigan.—Factory, Kitt Green; H. J. Heinz & Co., Ltd., London, N.W.10.

Wolverhampton.—Factory and offices, Fordhouse Road; British Industrial Engineering Co., Ltd., Lower Walsall Street.

York.—Proposed reconstruction of shops and offices at Leopard Arcade, Coney Street; W. Dootson, staff architect, Saxone, Ltd., Kilmarnock.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 22nd July:—

POWERS-SAMAS. No. 728,202, Class 9. Electrical apparatus and instruments, etc.—Powers-Samas Accounting Machines, Ltd., Powers-Samas House, Holborn Bars, London, E.C.1.

SONOGRAPH. No. 731,541, Class 9. Electrical and magnetic sound recording and sound reproducing apparatus. — Hartley Electromotives, Ltd., 37, Thurloe Street, South Kensington, London, S.W.7.

SOLARSCOPE. No. 735,237, Class 9. Electronic and electrical apparatus and instruments.—Solartron Electronic Group, Ltd., Solartron Works, Queens Road, Thames Ditton, Surrey.

MYSTO. No. 740,311, Class 9. Electrical apparatus and instruments and parts.—W. T. French & Son, Ltd., Mysto Works, Browning Street, Birmingham, 16.

STOVAC. No. 740,879, Class 9. Electrodes for electric welding.—Rockweld, Ltd., Commerce Way, Croydon, Surrey.

ULTRALUX. No. 736,579. ULTRASTRIP. No. 736,580, Class 11. Electric lighting fittings and parts.—Troughton & Young (Lighting), Ltd., 143, Knightsbridge, London, S.W.1.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 17th August from the Patents Office, 25, Southampton Buildings, London, W.C.2.

1951

12048. Hart, K. V.—Electric resistance welding device. 23rd May, 1951. (735284.)

21645. Parsons & Co., Ltd., C. A.—Heating units for combustion turbines. 15th September, 1952. (735186.)

27531. Svenska Aktiebolaget Gas-Accumulator.—Electric arc stud welding or soldering guns. 23rd November, 1951. (735105.)

29813. Hann, D. G.—Electrically heated glass furnaces. 16th December, 1952. (735222.)

29903. Orton, T. B.—Electrical apparatus for the therapeutic treatment of disease. 15th September, 1952. Cognate application 21596, 27th August, 1952. (735290.)

1952

2773. General Electric Co., Ltd., and Cates, J.—Electric circuit arrangements for operating electric discharge lamps. 13th February, 1953. (735226.)

7863. Graviner Manufacturing Co., Ltd., Wilkinson Sword Co., Ltd., and Bennett, N. G.—Inertia operated electric switches. 12th March, 1953. (735297.)

7917. Sangamo Weston, Ltd.—Electrical instruments. 27th March, 1952. (735298.)

8424. Metropolitan-Vickers Electrical Co., Ltd.—Cathode-ray tube display apparatus. 27th March, 1953. (735188.)

8689. Standard Telephones & Cables, Ltd.—Automatic telephone systems. 4th April, 1952. (735109.)

9574. Siemens-Schuckertwerke Akt.-Ges.—Laminated cores for electric transformers, inductances and the like. 16th April, 1952. (735228.)

13529. Kollsman Instrument Corporation.—Polyphase supply circuit and frequency meter. 28th May, 1952. (735115.)

15650. Jones & Co. (Engineers), Ltd., W.—Error corrector for electric generators. 10th June, 1953. (735307.)

15782. Parsons & Co., Ltd., C. A.—Regenerative heat exchangers especially for combustion turbines. 15th September, 1952. (735176.) 15783. Regenerative heat exchangers. 17th September, 1952. (735177.)

16559. Lancashire Dynamo & Crypto, Ltd.—Apparatus for winding lengths of tape on elongated cores, such as electrical conductors. 18th June, 1953. (735179.)

17336. Metropolitan-Vickers Electrical Co., Ltd.—Insulation of the windings of dynamo-electric machines. 8th July, 1953. (735311.)

21337. General Electric Co.—Luminescent screens. 25th August, 1952. (735235.)

22102. Marconi's Wireless Telegraph Co., Ltd.—Radio direction finders. 23rd July, 1953. (735315.)

24369. Compagnie Générale de Télégraphie sans Fil.—Ceramic dielectric materials. 29th September, 1952. (735347.)

25715. Clevite Corporation.—Disc transducer. 14th October, 1952. (735319.)

28647. General Electric Co.—Electroluminescent cells. 13th November, 1952. (735239.)

28722. Simplex Electric Co., Ltd.—Mounting blocks for electrical accessories. 13th November, 1953. (735240.)

29753/4. Wilmot-Breeden, Ltd.—Electric control of fluid-actuated door opening and closing mechanism. 23rd November, 1953. (735324-5.)

30072. Sundstrand Machine Tool Co.—Automatic speed control systems employing variable speed drives. 27th November, 1952. (735194.)

30570. Standard Coil Products Co., Inc.—Fine tuning devices for television receivers. 2nd December, 1952. (735326.) 31749. Tuning devices for television receivers. 15th December, 1952. (735328.)

31580. Electric Furnace Co., Ltd.—Apparatus for the local heat treatment of elongated workpieces such as camshafts. 11th December, 1953. (735327.)

31786. United-Carr Fastener Corporation.—Electrical socket connectors. 20th November, 1953. (735241.)

1953

788. English Electric Co., Ltd.—Gimbal mechanisms. 1st January, 1954. (735359.)

1172. Jelson Electric, Ltd., and Moulson, J. P.—Electric switches, having resilient movable contacts. 13th January, 1954. (735360.)

1331. English Electric Co., Ltd.—Electrical transformers having on-load tap changing apparatus. 15th January, 1954. (735371.)

1653. Metropolitan-Vickers Electrical Co., Ltd.—Control of electrically driven textile machinery. 31st December, 1953. (735198.)

1927. Titan Co., Inc.—Electrolytic cell of the diaphragm type. 22nd January, 1953. (735372.)

1930. British Insulated Callender's Cables, Ltd.—Joints and terminations for electric cables. 21st January, 1954. (735199.)

4431. British Insulated Callender's Cables, Ltd.—Switch frogs for the overhead conductors of electric traction systems. 16th February, 1954. (735377.)

6196. General Electric Co., Ltd., and Elson, D. W.—Electric signalling systems of the kind using pulse code modulation. 5th March, 1954. (735251.)

6197. General Electric Co., Ltd., and Elson, D. W.—Apparatus for comparing the instantaneous values of two voltages. 5th March, 1954. (735252.)

7060. Siemens Bros. & Co., Ltd.—Fault signalling in telephone systems. 5th March, 1954. (735138.)

12131. Philips Electrical Industries, Ltd.—Apparatus embodying means for detecting ions. 1st May, 1953. (735386.)

13349. Hart, K. V.—Method for electric resistance welding. 23rd May, 1951. (735335.)

14350. Parsons & Co., Ltd., C. A.—Dynamo-electric machines. 18th May, 1954. (735142.)

14664. Bendix Aviation Corporation.—Magnetic deflection system for cathode-ray tubes. 26th May, 1953. (735259.)

17654. Emag Elektrizitäts-Ges.—Mechanical rectifiers. 25th June, 1953. (735261.)

19092. Telegraph Construction & Maintenance Co., Ltd.—Pressure-tight sealing of electric cables into housings. 1st July, 1954. (735399.)

19898. Soc. d'Applications et de Fabrications Industrielles S.A.F.I.—Automatic voltage regulation of a.c. generators. 17th July, 1953. (735400.)

20501. General Electric Co., Ltd., and Nixon, R. D.—Television receivers. 23rd July, 1954. (735402.)

23671. Przystawik, O.—Fountain installation and an electric circuit for operating same. 27th August, 1953. (735337.)

25083. Philips Electrical Industries, Ltd.—Adjustable magnetic electron lenses. 10th September, 1953. (735272.)

25168. Babcock & Wilcox, Ltd.—Fuel burner means. 11th September, 1953. (735409.)

25624. Daimler-Benz Akt.-Ges.—Apparatus for the electrical measurement of vibration oscillations. 16th September, 1953. (735410.)

27677. Mullard Radio Valve Co., Ltd.—Resistors. 8th October, 1953. Addition to 720955. (735164.)